This document is based on European standards and is not valid for use in U.S.A.

Optimized HW M238
System User Guide

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Schneider Electric

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Important Information

NOTICE Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result in** death, serious injury, or equipment damage.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result in** injury or equipment damage.

PLEASE NOTE Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved

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Before You Begin

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠ WARNING
UNGUARDED MACHINERY CAN CAUSE SERIOUS INJURY • Do not use this software and related automation products on equipment which does not have point-of-operation protection. • Do not reach into machine during operation. **Failure to follow these instructions can cause death, serious injury or equipment damage.**

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only the user can be aware of all the conditions and factors present during setup, operation and maintenance of the machine; therefore, only the user can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, the user should refer to the applicable local and national standards and regulations. A "National Safety Council's" Accident Prevention Manual also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products by itself cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks for point-of-operation protection have been installed and are operational before placing the equipment into service. All mechanical/electrical interlocks and safeties for point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of this Function Block (FB).

START UP AND TEST

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check be made and that enough time is allowed to perform complete and satisfactory testing.

⚠ CAUTION
EQUIPMENT OPERATION HAZARD • Verify that all installation and set up procedures have been completed. • Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices. • Remove tools, meters and debris from equipment. **Failure to follow these instructions can result in injury or equipment damage.**

Follow all start up tests recommended in the equipment documentation. Store all equipment documentation for future reference.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and grounds, except those grounds installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove ground from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

OPERATION AND ADJUSTMENTS

The following precautions are from NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and rating of components, there are hazards that can be encountered if such equipment is improperly operated.

- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.

- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

Introduction

Intention

This document is intended to provide a quick introduction to the described System. It is not intended to replace any specific product documentation. On the contrary, it offers additional information to the product documentation, for installing, configuring and implementing the system.

The architecture described in this document is not a specific product in the normal commercial sense. It describes an example of how Schneider-Electric and third-party components may be integrated to fulfil an industrial application.

A detailed functional description or the specification for a specific user application is not part of this document. Nevertheless, the document outlines some typical applications where the system might be implemented.

Abbreviations

Abbreviation	Signification
AC	Alternating Current
CB	Circuit Breaker
CFC	Continuous Function Chart – a programming language based on function chart
DI	Digital Input
DO	Digital Output
DC	Direct Current
DFB	Derived Function Blocks
EDS	Electronic Data Sheet
E-OFF, E-STOP	Emergency Off switch / Emergency Stop
FBD	Function Block Diagram – an IEC-61131 programming language
HMI	Human Machine Interface
I/O	Input/Output
IL	Instruction List - a textual IEC-61131 programming language
IP	Internet Protocol
LD	Ladder Diagram – a graphic IEC-61131 programming language
MBTCP	Communications protocol with Modbus over TCP (Ethernet)
MFB	PLCopen Motion Function Block
PC	Personal Computer
POU	Programmable Object Unit, Program Section in CoDeSys, ELOP II Factory and SoMachine
PDO	Process Data Object (CANopen)
PLC	Programmable Logic Controller
PS	Power Supply
RFID	**R**adio **F**requency **ID**entification
RTU	Remote Terminal Unit
RPDO	Receive Process Data Object (CANopen)
SE	Schneider Electric
SFC	Sequential Function Chart – an IEC-61131 programming language
SDO	Service Data Object
ST	Structured Text – an IEC-61131 programming language
SRS	**PLC**-**R**ack-**S**lot; Addressing system in ELOP II Factory
TCP	Transmission Control Protocol
TPDO	Transmit Process Data Object (CANopen)
UDP	User Data Protocol
VSD	Variable Speed Drive
WxHxD	Dimensions : Width, Height and Depth

Glossary

Expression	Signification
Advantys	SE product name for a family of I/O modules
Altivar (ATV)	SE product name for a family of VSDs
CANopen	Name for a communications machine bus system
CoDeSys	Hardware-independent IEC 61131-3 programming software
ConneXium	SE product name for a Family of Transparent Factory devices
ELOP II Factory	A component of the SafetySuite software
Harmony	SE product name for a family of switches and indicators
HIMatrix	HIMA product name for safety remote I/Os
IclA (ICLA)	SE product name for a compact drive
Lexium/LXM	SE product name for a family of servo-drives
Lexium Motion Controller/LMC/	SE product name for a multi-axis controller
M340 / Modicon M340	SE product name for a mid range PLC family
Magelis	SE product name for a family of HMI- and Graphic Controller-Devices
MB - SL	SE name for a serial Modbus communications protocol
Micro	SE product name for a middle range family of PLCs
Modbus	A Communications protocol
MotionPro	SE Product name for PLC programming software with CoDeSys
NIM	SE product name for a Network Interface Module
Osiswitch	SE product name for a family of position switches
Ositrack	SE product name for an Identification system
Phaseo	SE product name for a family of power supplies
PLCopen	An international standard for industrial controller programming.
PowerSuite	An SE software product for configuring drives
Premium	SE product name for a middle range family of PLCs
Preventa	SE product name for a family of safety devices
PS1131 (CoDeSys)	SE Product name for PLC programming software with CoDeSys
SafeEthernet	A safety protocol based on Modbus TCP/IP
SafetySuite	SE product name for a collection of safety software tools
SoMachine	SE product name for a PLC programming software
SyCon	SE product name of a Field bus programming software
Telefast	SE product name for a series of distributed I/O devices
TeSys U	SE product name for direct motor starters
Twido	SE product name of a basic range family of PLCs
TwidoSoft	SE product name for a PLC programming software
TwidoSuite	SE product name for a PLC programming software
Unity (Pro)	SE product name for a PLC programming software
Vijeo Designer	An SE software product for programming Magelis HMI devices
XBT-L1000	An SE software product for programming Magelis HMI devices
Zelio	SE product name for a low range PLC family
ZelioSoft	SE product name for a PLC programming software

Application Source Code

Introduction

Examples of the source code and wiring diagrams used to attain the system function as described in this document can be downloaded from our website.

The example source code is in the form of configuration, application and import files. Use the appropriate software tool to either open or import the files.

Extension	File Type	Software Tool Required
ACI	Project file	ELOP II Factory
AIW	Configuration file	Advantys Configuration Software
CNF	**C**onfiguratio**n F**ile	SyCon
CO	**C**AN**o**pen definitions file	SyCon
CSV	**C**omma **S**eperated **V**alues, Spreadsheet	Twidosoft
CTX		UnityPro
DCF	**D**evice **C**onfiguration **F**ile	Advantys Configuration Software
DIB	**D**evice **I**ndependent **B**itmap	SyCon
DOC	**Doc**ument file	Microsoft Word
DOP	Project File	Magelis XBTL 1000
EDS	**E**lectronic **D**ata **S**heet – Device Definition	Industrial standard
FEF	Export file	PL7 / UnityPro
GSD	EDS file (**G**eraete **S**tamm **D**atei)	Profibus
ISL	**Isl**and file, project file	Advantys Configuration Software
L2P	Project directory	ELOP II Factory
L3P	Project Archive directory	ELOP II Factory
PB	**P**rofi**b**us definitions file	SyCon
PDF	**P**ortable **D**ocument **F**ormat - document	Adobe Acrobat
PLD	Project file	ELOP II Factory
PLP	Project file	ELOP II Factory
PRO	Project file	PS1131 - CoDeSys
PROJECT	Project file	SoMachine
PS2	Export file	PowerSuite
RTF	**R**ich **T**ext **F**ile - document	Microsoft Word
SPA	Schneider Product Archive	TwidoSuite
STA	Project Archive	UnityPro
STU	Project file	UnityPro
STX	Project file	PL7
TLX	Project file	Twinline Control Tool
TWD	Project file	TwidoSoft
VD0	Project file	MoviTools
VDZ	Project file	Vijeo Designer
XEF	Export file	UnityPro
XPR	Project file	TwidoSuite
ZM2	Project file	ZelioSoft

Typical Applications

Introduction

Here you will find a list of the typical applications, and their market segments, where this system or subsystem can be applied:

Industrial

- Small to medium sized automated machines
- De-centralised automated sub systems serving as components in large or medium sized machines

Machines

- Packaging machines and box folders
- Palette wrappers

Food & Pharmaceuticals

- Drying plants
- Conveyor ovens

Application	Description	Image
Packaging machines or box folders.	These machines are often used as feeder components in larger confectioning and filling systems.	
Wrappers for palettes	These machines wrap palettes so that the layers of goods are securely held on the palette. These stand alone machines can be integrated into production lines.	
Drying plants and conveyor ovens	Used as Components in larger system where products need to be dried.	

System

Introduction

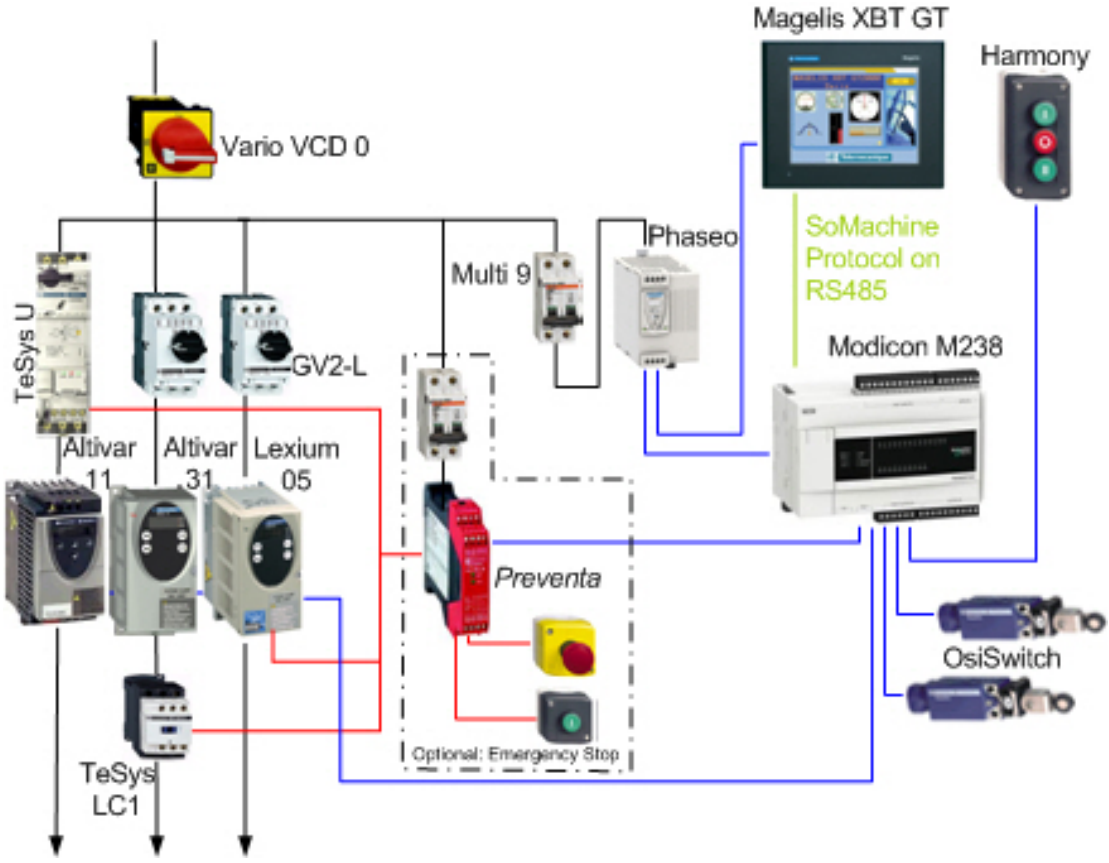
The system chapter describes the architecture, the dimensions, the quantities and different types of components used within this system.

Architecture

General

The PLC in this application is a Modicon M238. The user can control and monitor the application using the Magelis HMI device. The drives, which are hardwired to the PLC, are the Altivar 11, Altivar 31 and Lexium 05. As a functional safety option, the example application includes a tamper free emergency stop function monitored by a Preventa safety module.

Layout



Components

Hardware:

- Vario Switch Disconnector VCD0
- Phaseo ABL8 Power Supply Unit 230VAC/24VDC
- USIC Universal Signal Interface Converter 24VDC/5VDC
- Modicon M238 PLC with integrated Modbus interface
- Magelis XBT GT Colour Graphics Touch Screen Display Terminal
- Motor Circuit Breaker GV2-L (Short Circuit protected) for the motor drives
- TeSys U Motor Starter with LUCL Control Unit for use with VSDs
- TeSys D (LC1D) Contactors
- Variable speed drives Altivar 11 and Altivar 31
- Servo drive Lexium 05 with Servo Motor
- Multi 9 Circuit Breaker
- Harmony Emergency Stop Button XALK
- Harmony Illuminated Push Buttons XB5
- OsiSwitch Limit Switches
- Preventa E-Stop Safety Relay

Software:

- SoMachine V1.0
- PowerSuite V2.50

Quantities of Components

For a complete and detailed list of components, the quantities required and the order numbers, please refer to the components list at the rear of this document.

Degree of Protection

Not all the components in this configuration are designed to withstand the same environmental conditions. Some components may need additional protection, in the form of housings, depending on the environment in which you intend to use them. For environmental details of the individual components please refer to the list in the appendix of this document and the appropriate user manual.

Technical Data

Mains voltage	400V AC
Power requirement	~ 3 kW
Drive power rating	1x 0,37 kW, 2x 0,75 kW
Motor brake	none
Connection	5x 2,5mm² (L1, L2, L3, N, PE)
Functional Safety Level	Cat. 2 (optional)

Functional Safety Notice

(EN954-1)

The standard and level of functional safety you apply to your application is determined by your system design and the overall extent to which your system may be a hazard to people and machinery.

As there are no moving mechanical parts in this application example, category 2 (according to EN954-1) has been selected as an optional functional safety level.

Whether or not the above functional safety category should be applied to your system should be ascertained with a proper risk analysis.

This document is not comprehensive for any systems using the given architecture and does not absolve users of their duty to uphold the functional safety requirements with respect to the equipment used in their systems or of compliance with either national or international safety laws and regulations

Dimensions

The dimensions of the individual devices used; PLC, Drive, Power supply, etc. require a housing cabinet size of at least 1000x600x400mm (WxHxD).

The HMI display, illuminated indicators such as „SYSTEM ON“, „SYSTEM OFF“ or „ACKNOWLEDGE EMERGENCY OFF“ as well as the emergency stop switch itself, can be built into the door of the housing.

Installation

Introduction

This chapter describes the steps necessary to set up the hardware and configure the software required to fulfil the described function of the application.

Assembly

Notes

The components designed for installation in a cabinet, i.e. the PLC, safety module, circuit breakers, contactors, motor circuit breakers, power supply, TeSysU motor starters and M238 I/O modules can be mounted on a 35 mm top-hat rail.

Master switches, solid state relays, Lexium 05 servo drives and Altivar variable speed drives are installed directly onto the mounting plate. Alternatively the Altivar 31 and Lexium 05 can be mounted on a top-hat rail if an adapter is used.

The emergency stop button and the pushbutton housing for the display and acknowledgement indicators are designed for on-wall mounting in the field. All switches can also be installed directly in a cabinet (e.g., in the cabinet door) without special housings.

There are two options for installing XB5 pushbuttons and indicator lamps. They can be installed either a 22 mm hole cut into the front door of the control cabinet, or mounted in an XALD-type housing suitable for up to 5 pushbuttons or indicator lamps. The XALD pushbutton housing is designed for backplane assembly or direct wall mounting.

400VAC/3-phase or 230VAC/1-phase wiring for the motion and drive circuitry (LXM05, ATV31, ATV11, TeSysU).

230VAC wiring for the power supply.

24VDC wiring for control circuits and the PLC power supply, I/O modules and the HMI.

The individual components must be interconnected in accordance with the detailed circuit diagram in order to ensure that they function correctly.

SoMachine cables are installed for the communication link between the PLC and the HMI.

The HALT input of the LXM05 (Pin 36 of CN1) must be connected and supplied with +24VDC to enable the LXM05 to run in the selected operating mode.

A coupling relay is used between the DO output of ATV11 and the sink transistor input of the PLC.

Pin 9, 10, 11 and 15 of USIC CN1 are connected to the same grounding terminal.

The modules and I/O listed here are a representative cross section of the modules and indicators required to implement the application as defined in this document and may differ from your own specific application.

M238 I/O Connections

Type	I/O	Designation
M238- PLC Inputs	I 0	Not used, reserved for fast counters
	I 1	Not used, reserved for fast counters
	I 2	Not used, reserved for fast counters
	I 3	Not used, reserved for fast counters
	I 4	Not used, reserved for fast counters
	I 5	Not used, reserved for fast counters
	I 6	Not used, reserved for fast counters
	I 7	Not used, reserved for fast counters
	I 8	Preventa Safety Relay Terminal Y44
	I 9	Position 1 of 3-Position Selector Switch
	I 10	Position 2 of 3-Position Selector Switch
	I 11	N/C Contact of Red Illuminated Push Button
	I 12	(Reverse) Limit Switch
	I 13	(Forward) Limit Switch

M238 I/O Connections	M238- PLC Outputs	Q 0 Q 1 Q 2 Q 3 Q 4 Q 5 Q 6 Q 7 Q 8 Q 9	USIC Pin 1 of CN1 (PULSE Signal) USIC Pin 2 of CN1 (DIR Signal) Not used, reserved for fast outputs Not used, reserved for fast outputs USIC Pin 3 of CN1 (ENABLE Signal) Red signal lamp of Push Button Blue signal lamp of Push Button ATV11 LI1 (Forward Run Command) ATV11 LI2 (Reverse Run Command) ATV11 LI3 (Alarm Reset Command)
M238 Wiring	M238- PLC Power Supply	G0 G2 G4 G6 C8 V0+ V0- V1+ V1- V2+ V2-	0V DC reference potential 0V DC reference potential 0V DC reference potential 0V DC reference potential 0V DC reference potential +24V DC 0V DC reference potential +24V DC 0V DC reference potential +24V DC 0V DC reference potential
TM2DDI16DT I/O Connections	TM2DDI16DT - Digital Inputs Module	I 0 I 1 I 2 I 3 I 4 I 5 I 6 I 7 I 8 I 9 I 10 I 11 I 12 I 13 I 14 I 15	TeSys U LUFN N/O Auxiliary Contact ATV11 Alarm Relay, RA ABS2EC01EB Coupling Relay Terminal -14 ATV31 MCB N/O Auxiliary Contact ATV31 Relay R1A (Alarm) ATV31 Relay R2A (Speed Reached) LXM05 MCB N/O Auxiliary Contact LXM05 Pin 31 of CN1 (“NO_FAULT_OUT”) LXM05 Pin 32 of CN1 (ACTIVE1_OUT) Reserve Reserve Reserve Reserve Reserve Reserve Reserve
TM2DDI16DT Wiring	TM2DDI16DT - Digital Inputs Module Power Supply	COM COM COM COM	0V DC reference potential 0V DC reference potential 0V DC reference potential 0V DC reference potential
TM2DDO8TT I/O Connections	TM2DDO8TT- Digital Outputs Module	Q 0 Q 1 Q 2 Q 3 Q 4 Q 5 Q 6 Q 7	ATV31 LI1 (Forward Run Command) ATV31 LI2 (Reverse Run Command) ATV31 LI3 (Alarm Reset Command) Preventa Safety Relay Terminal 13 LXM05 Pin 34 of CN1 (“FAULT_RESET”) Reserve Reserve Reserve
TM2DDO8TT Wiring	TM2DDO8TT- Digital Outputs Module Power Supply	COM (+) -V	+24V DC 0V DC reference potential
TM2AMM3HT I/O Connections	TM2AMM3HT - Analogue Mixed Module Inputs	IN0 (+) IN0 (-) IN1 (+) IN1 (-)	Reserve Reserve Reserve Reserve

	TM2AMM3HT - Analogue Mixed Module Outputs	OUT (+) OUT (-)	ATV11 AI1 Terminal ATV11 0V Terminal ATV31 AI1 Terminal
TM2AMM3HT Wiring	TM2AMM3HT - Analogue Mixed Module Power Supply	+ - COM (IN0/IN1) COM (IN2/IN3) COM (OUT0) COM (OUT1)	+24V DC 0V DC reference potential Reserve Reserve ATV11 0V Terminal ATV31 COM Terminal
TM2ALM3LT I/O Connections	TM2ALM3LT- Analogue Mixed Module Inputs	IN0 (+) IN0 (-) IN1 (+) IN1 (-)	Reserve Reserve Reserve Reserve
	TM2ALM3LT- Analogue Mixed Module Outputs	OUT (+) OUT (-)	ATV31 AI1 Terminal ATV31 COM Terminal
TM2ALM3LT Wiring	TM2ALM3LT- Analogue Mixed Module Power Supply	+ -	+24V DC 0V DC reference potential

Wiring Motor Drives

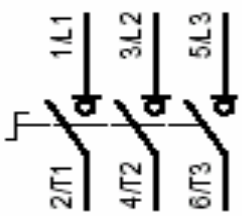
ATV11	LI1 LI2 LI3 RA RC DO AI1 0V	M238 Q7 M238 Q8 M238 Q9 TM2DDI16DT I1 +24V DC ABS2EC01EB Coupling Relay Terminal A2 TM2AMM3HT OUT (+) TM2AMM3HT OUT (-) and 0V DC reference potential
ATV31	LI1 LI2 LI3 CLI R1A R1C R2A R2C AI1 COM	TM2DDO8TT Q0 TM2DDO8TT Q1 TM2DDO8TT Q2 0V DC reference potential TM2DDI16DT I4 +24V DC TM2DDI16DT I5 +24V DC TM2ALM3LT OUT (+) TM2ALM3LT OUT (-)
LXM05-CN1	31 32 33 34 35 36 37 38 39	TM2DDI16DT I7 (“NO_FAULT_OUT”) TM2DDI16DT I8 (ACTIVE1_OUT) Reserve (REF) TM2DDO8TT Q4 (“FAULT_RESET”) Reserve (ENABLE) Reserve (HALT) Preventa Safety Relay Terminal 33 (PWRR_A) LXM05 Pin 37 of CN1 (PWRR_B) Preventa Safety Relay Terminal 34 (+24VDC)
LXM05-CN3	41 43	0V DC reference potential +24V DC

Master Switch for Door Mounting

Vario

VCD 0

3-Pole
400V
Rotary Switch

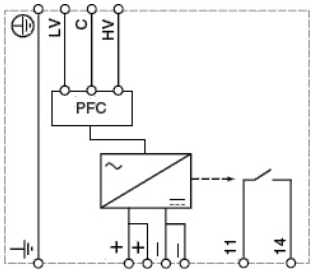


Power Supply

Phaseo

ABL 8RPS24050

Primary 200…500 VAC,
Secondary 24 VDC,
120W, 5A

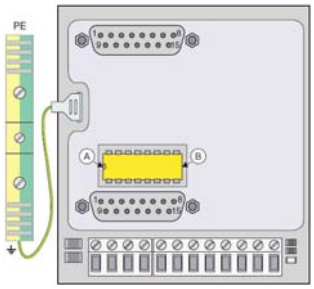


Universal Signal Interface Converter

USIC

VW3 M3 102

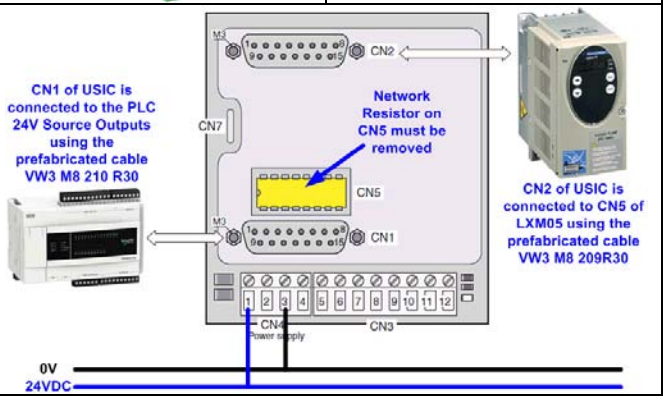
Universal adapter for a Pulse/Direction interface to a PLC



AB is the Resistor Network

The PLC is connected to CN1 of USIC using the PLC-USIC cable VW3 M8 210 R30

The LXM05 is connected to CN2 of USIC using the LXM05-USIC cable
VW3 M8 209R30


CN1 of USIC is connected to the PLC 24V Source Outputs using the prefabricated cable VW3 M8 210 R30
CN2
CN7
Network Resistor on CN5 must be removed
CN5
CN1
CN4
CN3
CN2 of USIC is connected to CN5 of LXM05 using the prefabricated cable VW3 M8 209R30
0V
24VDC

Universal Signal Interface Converter

Minimum cabling required as follows:

PLC <-> USIC CN1

Q0 PULSE (White)
Q1 DIR (Green)
Q4 ENABLE (Grey)

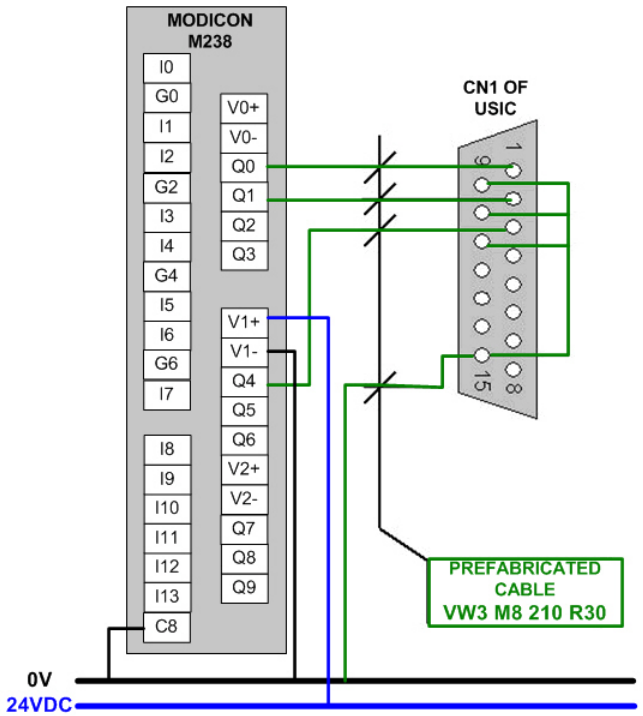
USIC CN1 <-> 0V

Pin9 -PULSE (Brown)
Pin10 -DIR (Yellow)
Pin11 -ENABLE (Pink)
Pin15 0VDC (White/Yellow)

USIC CN4 <-> Power Supply

Pin 1 24 VDC
Pin3 0V

IMPORTANT:
The Yellow Resistor Network that is connected on CN5 of USIC must be removed.



Assignment of CN1 and CN2

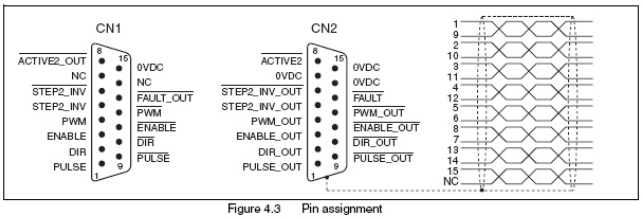


Figure 4.3 Pin assignment

Pin	Signal CN1	Signal CN2	Colour [1]	Meaning	I/O (CN1)	I/O (CN2)
1	PULSE	PULSE_OUT	white	Motor step (+)	I	O
9	$\overline{\text{PULSE}}$	$\overline{\text{PULSE\_OUT}}$	brown	Motor step, inverted (-)	I	O
2	DIR	DIR_OUT	green	Direction of rotation (+)	I	O
10	$\overline{\text{DIR}}$	$\overline{\text{DIR\_OUT}}$	yellow	Direction of rotation, inverted (-)	I	O
3	ENABLE	ENABLE_OUT	grey	Enable signal (+)	I	O
11	$\overline{\text{ENABLE}}$	$\overline{\text{ENABLE\_OUT}}$	pink	Enable signal, inverted (-)	I	O
4	PWM [2]	PWM_OUT [2]	blue	Current reduction (+)	I	O
12	$\overline{\text{PWM}}$	$\overline{\text{PWM\_OUT}}$	red	Current reduction, inverted (-)	I	O
5	STEP2_INV [2]	STEP2_INV_OUT [2]	black	Angular resolution transfer (+)	I	O
6	$\overline{\text{STEP2\_INV}}$	$\overline{\text{STEP2\_INV\_OUT}}$	purple	Angular resolution transfer, inverted (-)	I	O
8	$\overline{\text{ACTIVE2\_OUT}}$	$\overline{\text{ACTIVE2}}$	red/blue	0: Power amplifier is enabled 1: Power amplifier is locked	O	I
13	$\overline{\text{FAULT\_OUT}}$ [2] [3]	$\overline{\text{FAULT}}$	white/green	0: Normal operating status 1: Error message	O	I
15	0VDC	0VDC	white/yellow	ground	-	-
7	NC	0VDC	grey/pink	ground	-	-
14	NC	0VDC	brown/green	ground	-	-

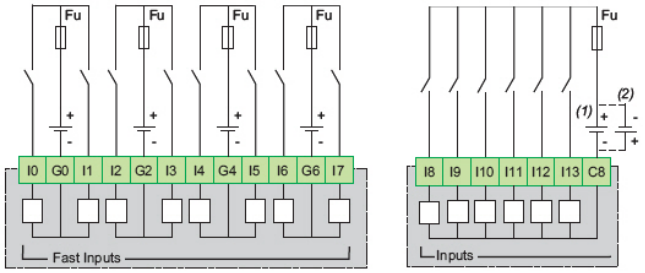
1) Information on colour refers to the wires available as accessories.
2) Pins are not assigned with all power amplifiers.
3) At Twin Line the signal is called $\overline{\text{FUNCT\_OUT}}$

Modicon M238

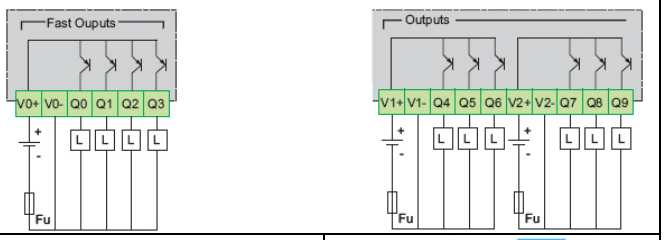
TM238LFDC24DT

14 Digital Inputs incl. 8 Fast Inputs, 10 Digital Outputs incl. 4 Fast Outputs

Modicon M238



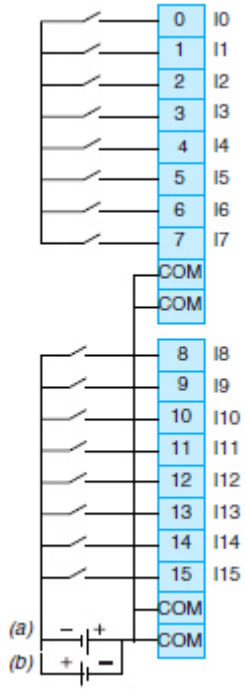
(1) Sink inputs (positive logic)
(2) Source inputs (negative logic)



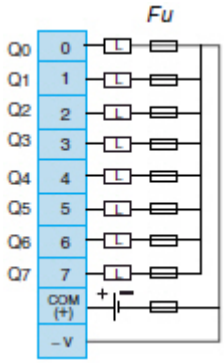
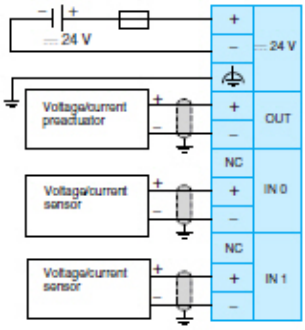
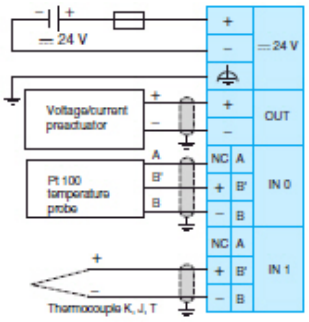
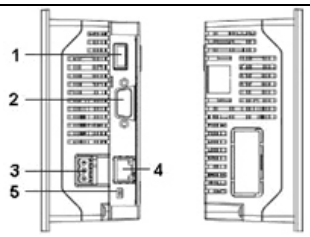
Modicon M238 Module

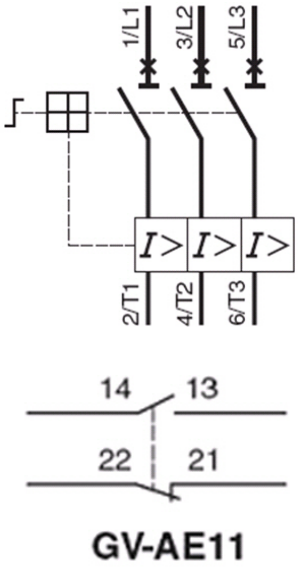
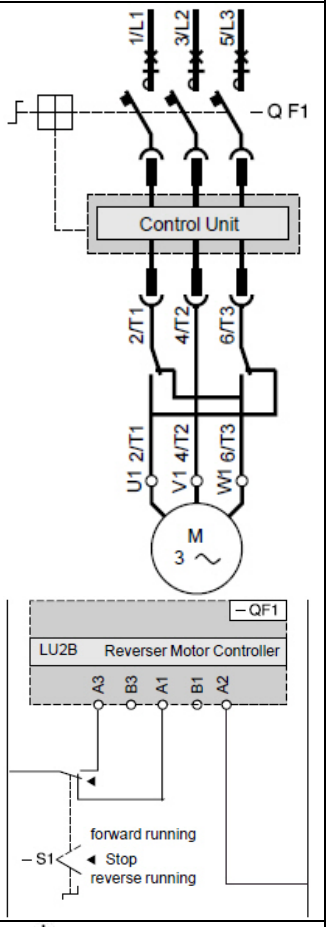
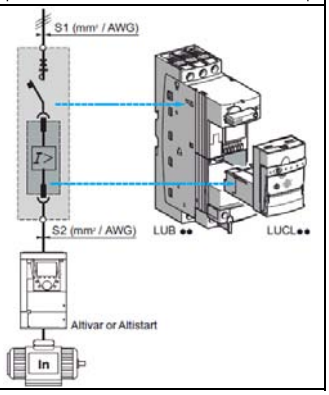
TM2DDI16DT

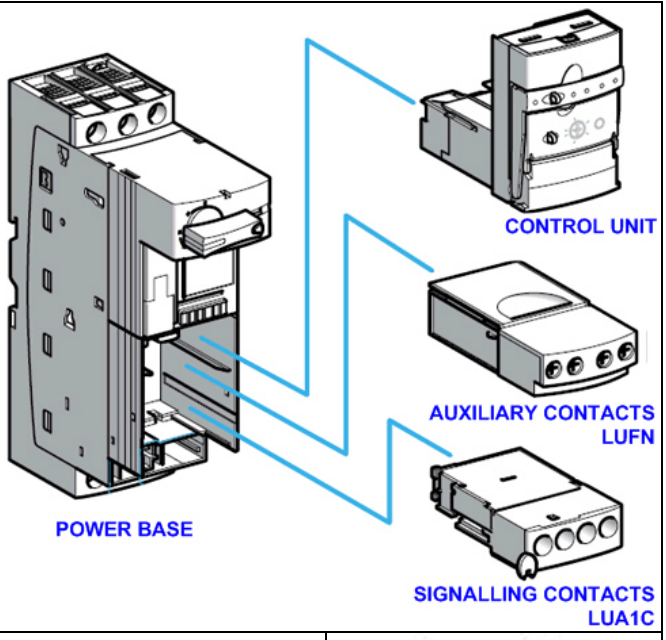
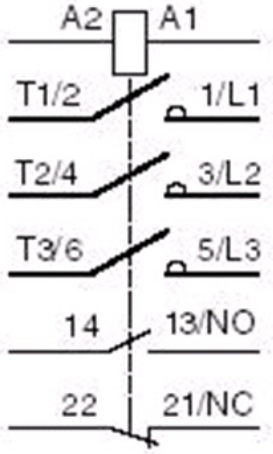
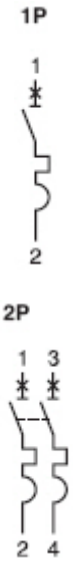
16 Digital Inputs, 24VDC Sink/Source, Removable Screw Terminal Block



(a) Source inputs (negative logic)
(b) Sink inputs (positive logic)

Modicon M238 Module **TM2DDO8TT** 8 Digital Source Outputs, 24VDC, Removable Screw Terminal Block		 **Fu:0.3A quick-blow fuse**
Modicon M238 Module **TM2AMM3HT** 2 Analog Inputs (0…10V / 4…20mA) 1 Analog Output (0..10V / 4..20mA)		
Modicon M238 Module **TM2ALM3LT** 2 Analog Inputs (Thermocouple K, J, T and PT 100 Temperature Probe), 1 Analog Output (0…10V / 4…20mA)		
HMI Touch Screen Display **Magelis** **XBTGT2330** 24VDC Input, TFT Colour LCD, 320 x 240 Pixels, 65536 Colours, 16 MB Application Flash EPROM with Built-in Ethernet	 	 1. **USB interface** 2. **Serial interface COM1** 3. **Power supply connector** 4. **Serial interface COM2** 5. **(RJ45) Polarisation Switch**

Motor Circuit Breaker (Short Circuit Protected) **GV2L07** and **GV2L14** Used together with auxiliary contact **GVAE11**		
Motor Starter **TeSys U** **LU2B12BL** Reversing power base Used together with auxiliary contact **LUFN20** Optional signalling contact **LUA1C20**		
TeSys U Motor Starter **LUCL12BL** **Control Unit** Magnetic control unit for the protection of variable speed controllers and soft starter units		

Motor Starter **TeSys U** **LU2B12BL** **&** **LUCL12BL** & **LUFN20** & **LUA1C20**		
Contactor **TeSysD** **LC1D09BD**		
Circuit Breaker **Multi 9** **23726, 23747, 24518, 26135** and **23756**	 	

Variable Speed Drive

Altivar 11

ATV11 PU18 M2E

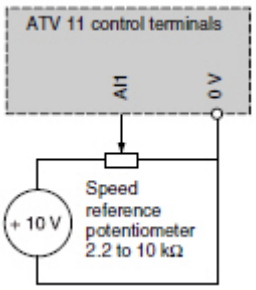
1-phase

230VAC, 0,75kW

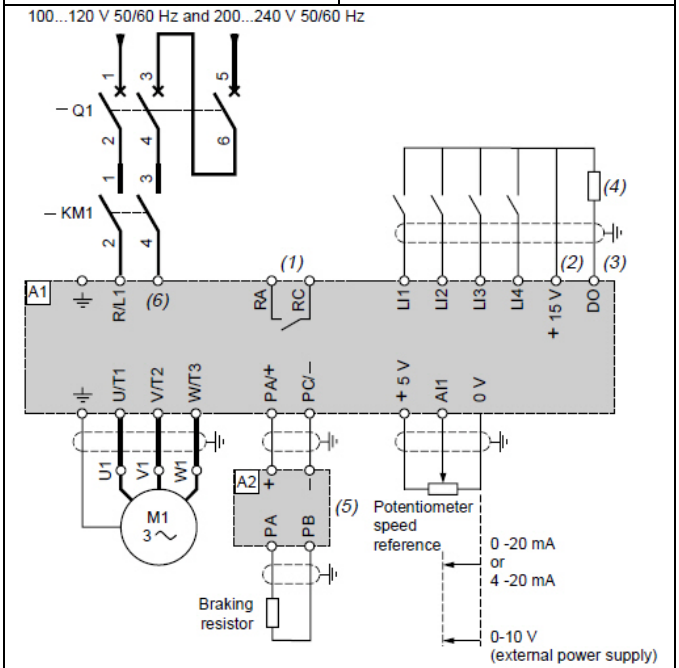
To ensure that the logic inputs can be energized using PLC transistor outputs:

Connect the 0 V terminal of the ATV11 directly to the 0V DC reference potential.

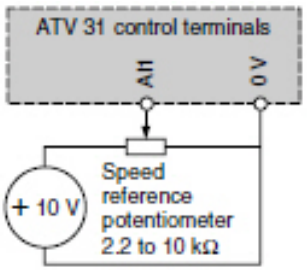
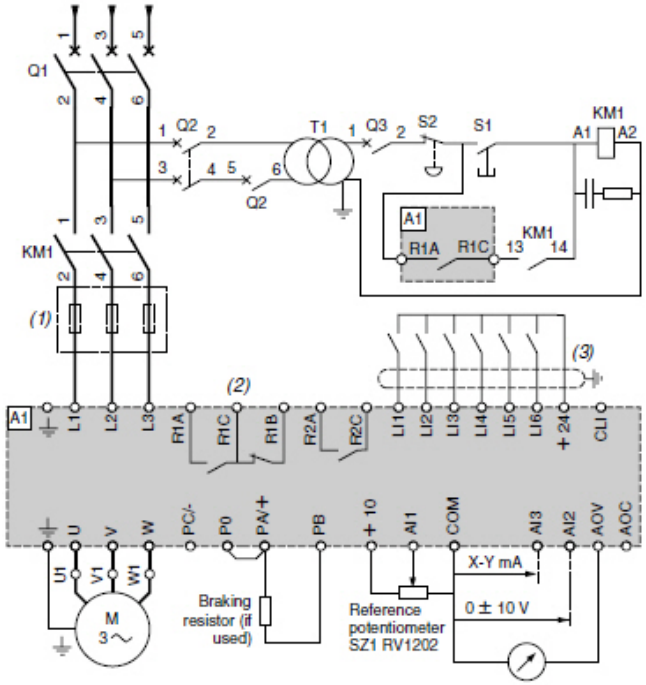
Note:
Connecting the ATV11 0 V terminal to the COM terminal of the Analogue Output module does not guarantee that the 0 V terminal of the ATV11 is connected to the 0V DC reference potential.

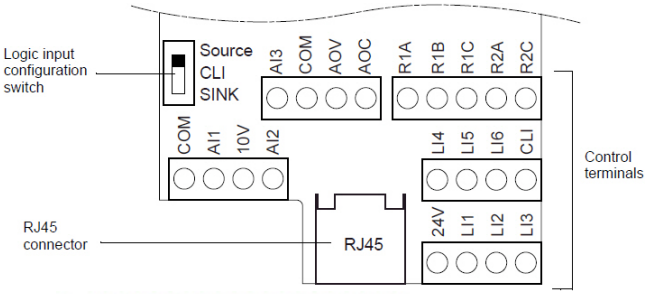
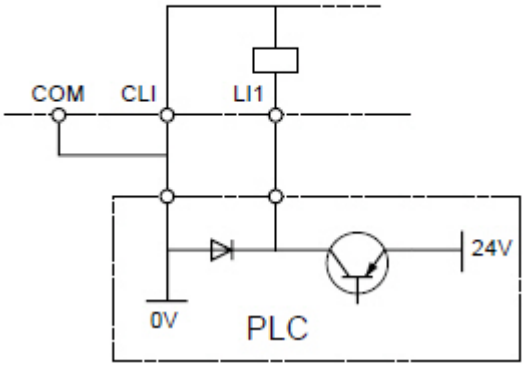


External 0…10V Analogue Signal as Speed Reference



(1) Alarm relay contact: for remote signalling of drive status.
(2) Internal +15 V. If an external +24 V supply is used, connect the 0 V on the external supply to the 0 V terminal, do not use the + 15 terminal on the drive, and connect the common of the LI inputs to the + 24 V of the external supply.
(3) DO output: can be configured as an analog or a logic output. Internal voltage + 15 V or external + 24 V.
(4) Galvanometer or low level relay.
(5) Braking module VW3 A11701, if braking resistor VW3 A587●● is used.

Variable Speed Drive **Altivar 31** **ATV31 H037 N4** 3-phase 400VAC, 0,37kW		 **External 0…10V Analogue Signal as Speed Reference**
Variable Speed Drive **Altivar 31**	 (1) Line choke (single phase or three phase) (2) Alarm relay contacts for remote signalling of the drive status (3) Connection of the common for the logic inputs depends on the position of the switch	

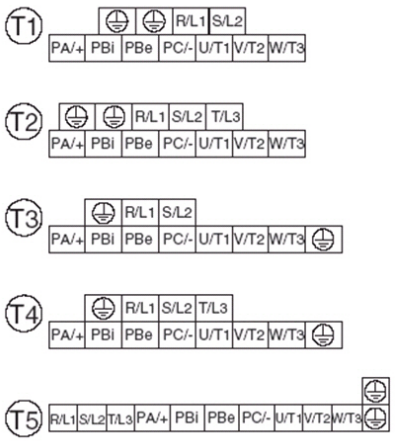
Variable Speed Drive **Altivar 31** **ATV31 H037 N4** **Control Panel** To ensure that the logic inputs can be energized using PLC transistor outputs: Toggle the logic input configuration switch to CLI position. Connect the CLI terminal to the 0V DC reference potential.	 • Switch in CLI position 
Servo Drive **Lexium05** **LXM05 AD10 M2** Single phase 230VAC, 0,75kW	

Servo Drive

Lexium05

LXM05 AD10 M2

Power Connection T1



LXM05•...	
D10F1	(T1)
D10M2	(T1)
D10M3X	(T2)
D14N4	(T4)
D17F1	(T3)
D17M2	(T4)
D17M3X	(T4)
D22N4	(T4)
D28F1	(T3)
D28M2	(T4)
D34N4	(T4)
D42M3X	(T4)
D57N4	(T5)

Power connections	Description
PE	Earth connection (protective earth)
R/L1, S/L2/N	Mains connection, single phase devices
R/L1, S/L2, T/L3	Mains connection, 3-phase devices
PA/+	DC bus
PBi	Braking resistor internal
PBe	Braking resistor external
PC/-	DC bus
U/T1,V/T2, W/T3	Motor connections

Servo Drive

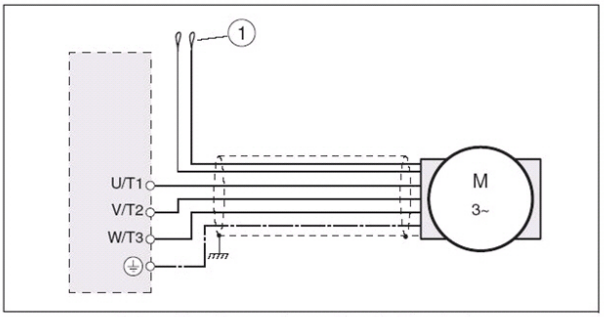
Lexium05

LXM05 AD10 M2

Motor Connection

Power Cable Connection to Motor (Length 3m)

VW3 M5101 R30



Motor wiring diagram, here without holding brake

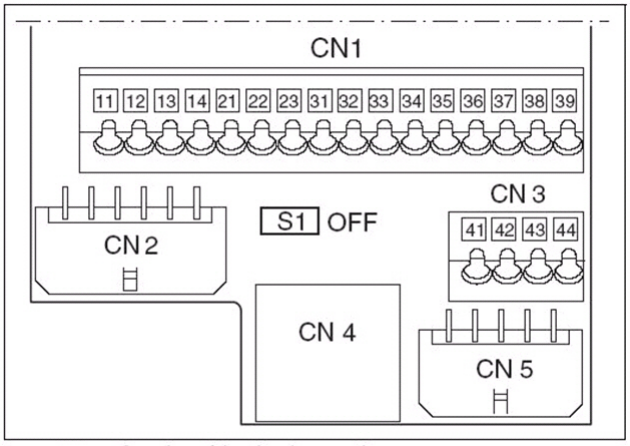
Terminal	Description	Colour
U/T1	Motor lead	black L1 (BK)
V/T2	Motor lead	black L2 (BK)
W/T3	Motor lead	black L3 (BK)
PE	Protective conductor	green/yellow (GN/YE)
(1)	Holding brake connection cable For motors with holding brake	white (WH), grey (GR)

Servo Drive

Lexium05

LXM05AD10M2

Control Panel Overview of the Signal Connectors



Overview of the signal connections

Connection/ switch	Assignments
CN1	Analogue inputs ±10V, pin 11 to 14
	CANopen, pin 21-23
	Digital inputs/outputs, pin 31-39
CN2	Motor encoder (Hiperface Sensor)
CN3	24V PELV controller supply voltage
CN4	PC, peripheral operating terminal, Modbus, CANopen;(RJ45)
CN5	ESIM (A/B/I out), PULSE/DIR in, encoder signals A/B/I in [1)]
S1	Switch for fieldbus terminating resistor

1) depending on the "First Setup"

Servo Drive

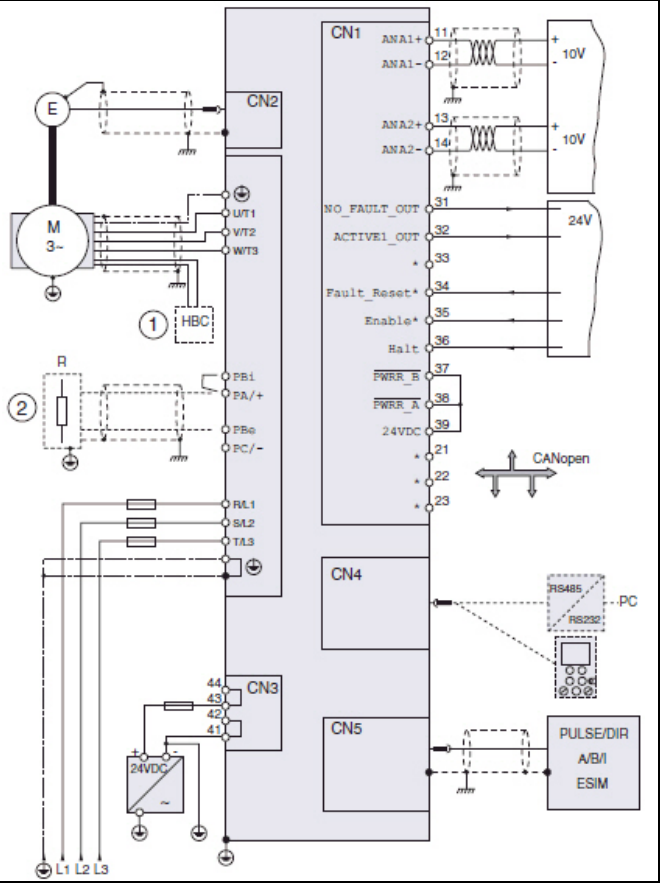
Lexium05

LXM05AD10M2

Signal Connectors CN1 and CN3

The connection of the following terminals are mandatory:

CN1 Terminal 31-32, 34-39
CN3 Terminal 41
CN3 Terminal 43



Servo Drive

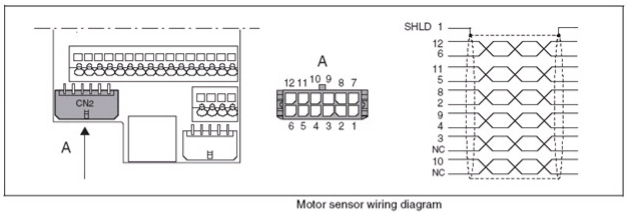
Lexium05

LXM05AD10M2

Signal Connectors CN2

A: Encoder Cable Connection to Motor (Length 3m)

VW3 M8101 R30



Motor sensor wiring diagram

Pin	Signal	Motor, pin	Colour [1]	Pair	Description	I/O
1	SHLD				Shielding braid	
12	SIN	8	white	1	Sine signal	E
6	REFSIN	4	brown	1	Reference for sine signal, 2.5 V	A
11	COS	9	green	2	Cosine signal	E
5	REFCOS	5	yellow	2	Reference for cosine signal, 2.5V	A
8	Data	6	grey	3	Receive and transmit data	I/O
2	$\overline{\text{Data}}$	7	pink	3	Receive and transmit data, inverted	I/O
10	ENC_0V	11	blue	4	sensor reference potential (encoder) (0.5mm²)	A
			red	4	not assigned (0.5mm²)	
3	TMOT_0V	1	black	5	Reference potential for T_MOT	-
			purple	5	not assigned	
9	T_MOT	2	grey/pink	6	temperature sensor PTC	E
4	ENC+10V_OUT	10	red/blue	6	10 V_{DC} power supply for sensor, max. 150 mA	A
7	n.c.				not assigned	

1) Colour data is based on the prefabricated cables

Servo Drive

Lexium05

LXM05AD10M2

Signal Connectors CN5

A: Pulse/Dir Cable Connection to USIC (Length 1.5m)

VW3M8209R15

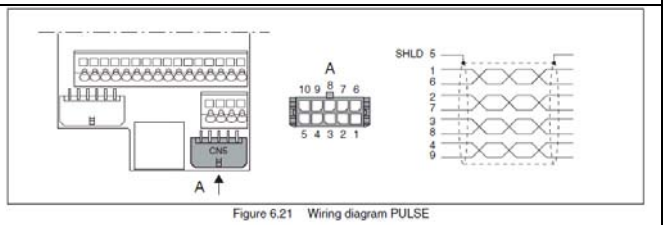


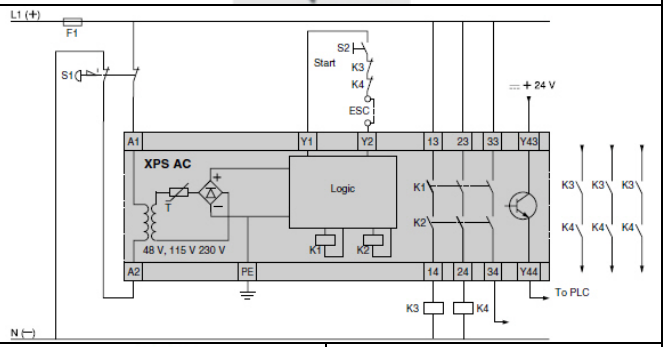
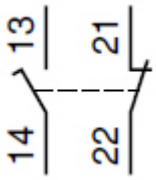
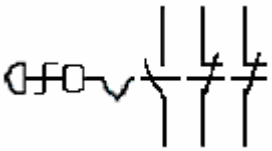
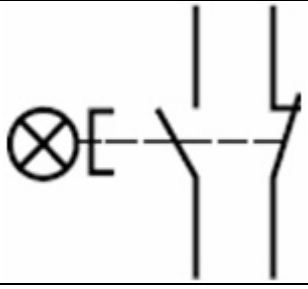
Figure 6.21 Wiring diagram PULSE

Pin	Signal	Colour [1]	Description	I/O
1	PULSE	white	Motor step "Pulse"	RS422 input signal
6	$\overline{\text{PULSE}}$	brown	Motor step "Pulse", inverted	RS422 input signal
2	DIR	green	direction of rotation "DIR"	RS422 input signal
7	$\overline{\text{DIR}}$	yellow	direction of rotation "Dir", inverted	RS422 input signal
3	ENABLE	grey	Enable signal	RS422 input signal
8	$\overline{\text{ENABLE}}$	pink	Enable signal, inverted	RS422 input signal
4	ACTIVE2_OUT	red	Drive ready	Open collector
9	POS_0V	blue	Reference potential	-
5	SHLD		Shield	
10	nc		not assigned	

Servo Motor

BSH0552T02A2A

Connected to Motor Terminals and CN2 of LXM05 using cables VW3 M5101 R30 and VW3 M8101 R30 respectively.

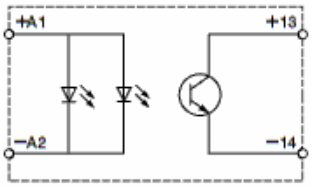
Safety Module **Preventa** **XPS AC5121**	 	
Limit Switch **OsiSwitch** **XCK P2118P16**		
Emergency Stop **Harmony** **XB5AS844 + B5AZ141** **Incl. E-STOP Label ZBY8330**	 	
Illuminated Pushbutton **Harmony Style 5** **XB5**		

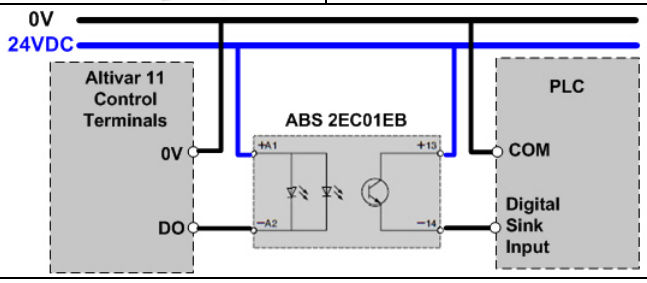
Interface Module

ABS2EC01EB

For Digital Signals

Used as a coupling relay between the ATV11 DO terminal and the PLC's Digital Input





Software

General

The main programming work lies in the programming of the Modicon M238 PLC, the configuration of the variable speed drives and creating the screens for the HMI display.

SoMachine software is used to program the Modicon M238 PLC.

Vijeo Designer software, which is integrated in SoMachine, is used to develop the HMI screens for Magelis XBTGT 2330 HMI.

Although the variable speed drives can be configured using the front panel on the drives, it is recommended to use the PowerSuite tool. PowerSuite offers more flexibility when configuring Schneider Electric ATV drives. It also allows the user to save and archive as well as test and make online adjustments to the configuration.

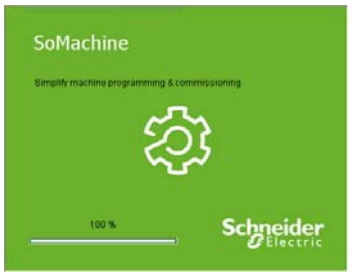
To use the software packages, your PC must have the appropriate Microsoft Windows operating system installed:

- Windows XP Professional

The software tools have the following default install paths:

- SoMachine

  C:\Program Files\Schneider Electric\SoMachine



- Vijeo Designer (Installed with SoMachine)

  C:\Program Files\Schneider Electric\Vijeodesigner

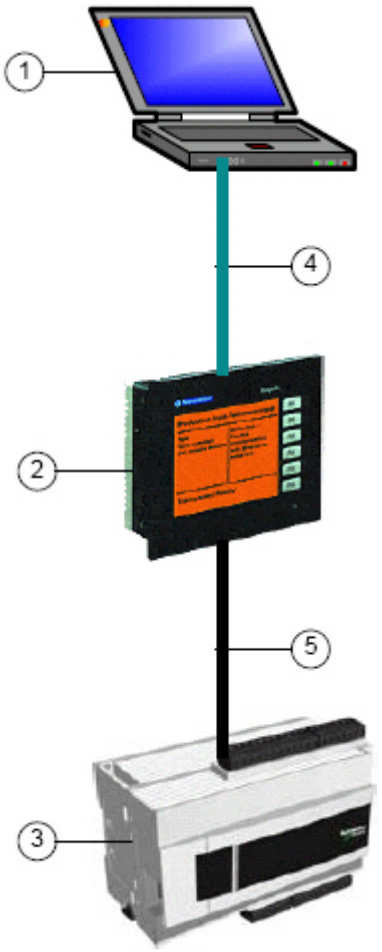
- PowerSuite

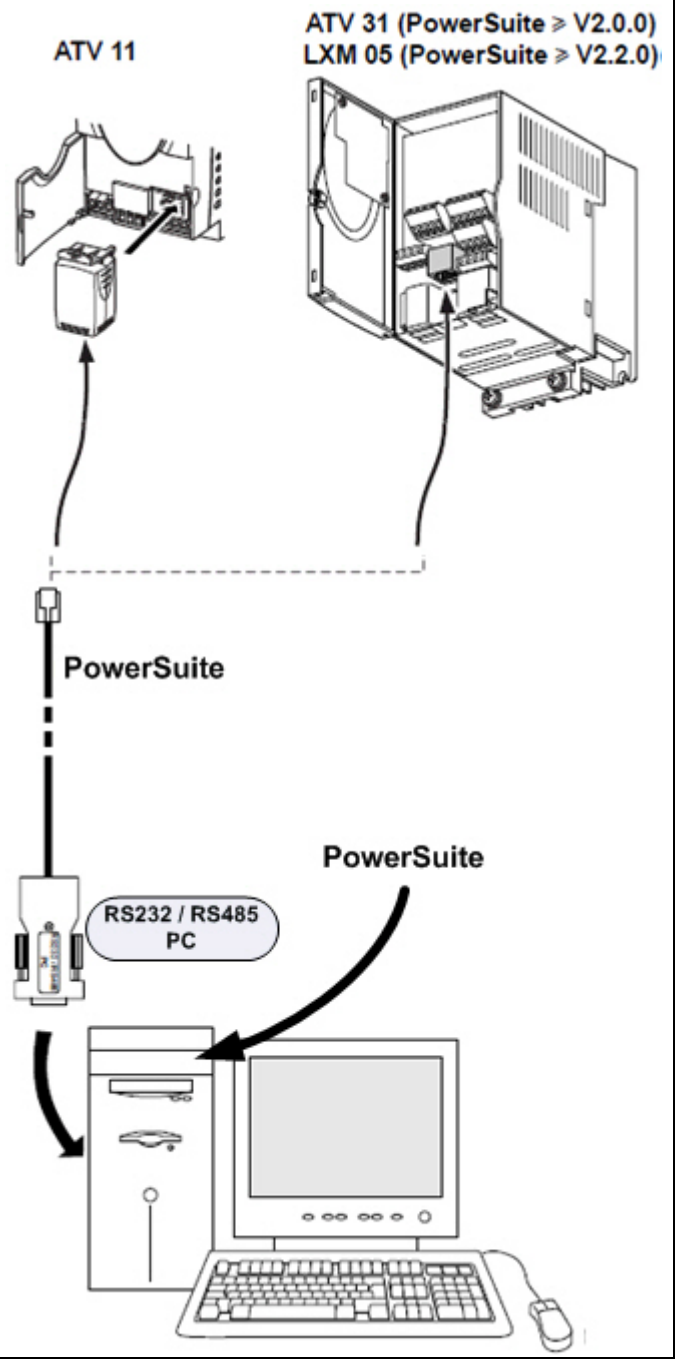
  C:\Program Files\Schneider Electric\PowerSuite

Communication

General

The Modicon M238 and the Magelis HMI communicates via the SoMachine protocol on RS485. The download from the PC to the M238 and to the HMI is conducted over one connection. The PC has to be connected to the HMI and then via this connection the data is also sent across to the M238.
PowerSuite, used for configuring the drive parameters, uses the Modbus port on the Drives.

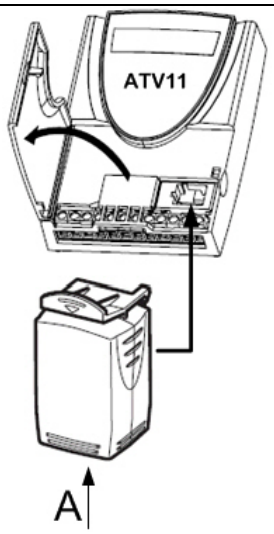
PC ↔ XBTGT ↔ M238 The download direction is from the PC to the HMI and via the HMI to the M238 Note: For a direct connection to the PLC the BMXXCAUSBH045 cable can be used	 **1. PC** **2. HMI XBT GT** **3. Modicon M238** **4. USB to USB cable XBTZG935** **5. SubD9 (HMI) to RJ45 (M238) cable XBTZ9008**
PC ↔ XBTGT **PC connection cable** **XBTZG935** Cable for the connection between a SoMachine-equipped PC and XBTGT	

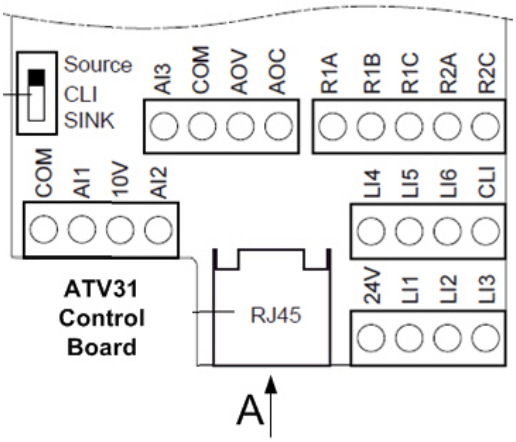
XBTGT ↔ M238 **PLC ↔ HMI connection cable** **XBTZ9008** Cable for the connection between a XBTGT and a M238 PLC	
Altivar 11 **Altivar 31** **Lexium 05** **PC connection cable** **VW3A8106** Cable for the connection between a PowerSuite-equipped PC and Altivar /Lexium05	

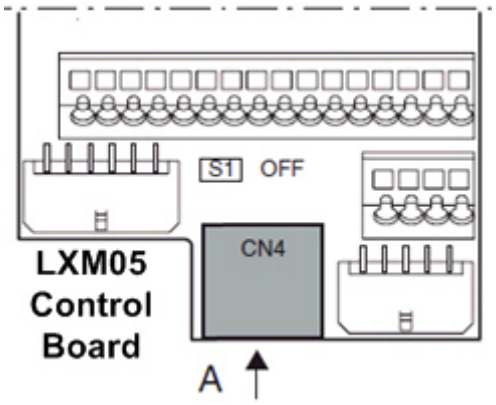
Altivar 11
Altivar 31
Lexium 05

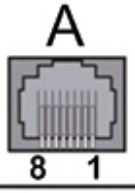
Modbus Network

The RJ45 interface features a Modbus port for establishing a PC and PowerSuite software connection.









Pin	Signal	Description	
4	MOD_D1	Bidirectional transmit/receive signal	RS485 level
5	MOD_D0	Bidirectional transmit/receive signal, inverted	RS485 level
7	MOD+10V_OUT	10 V power supply, max. 150 mA	Output
8	MOD_0V	Reference potential for MOD+10V_OUT	Output

Implementation

Introduction

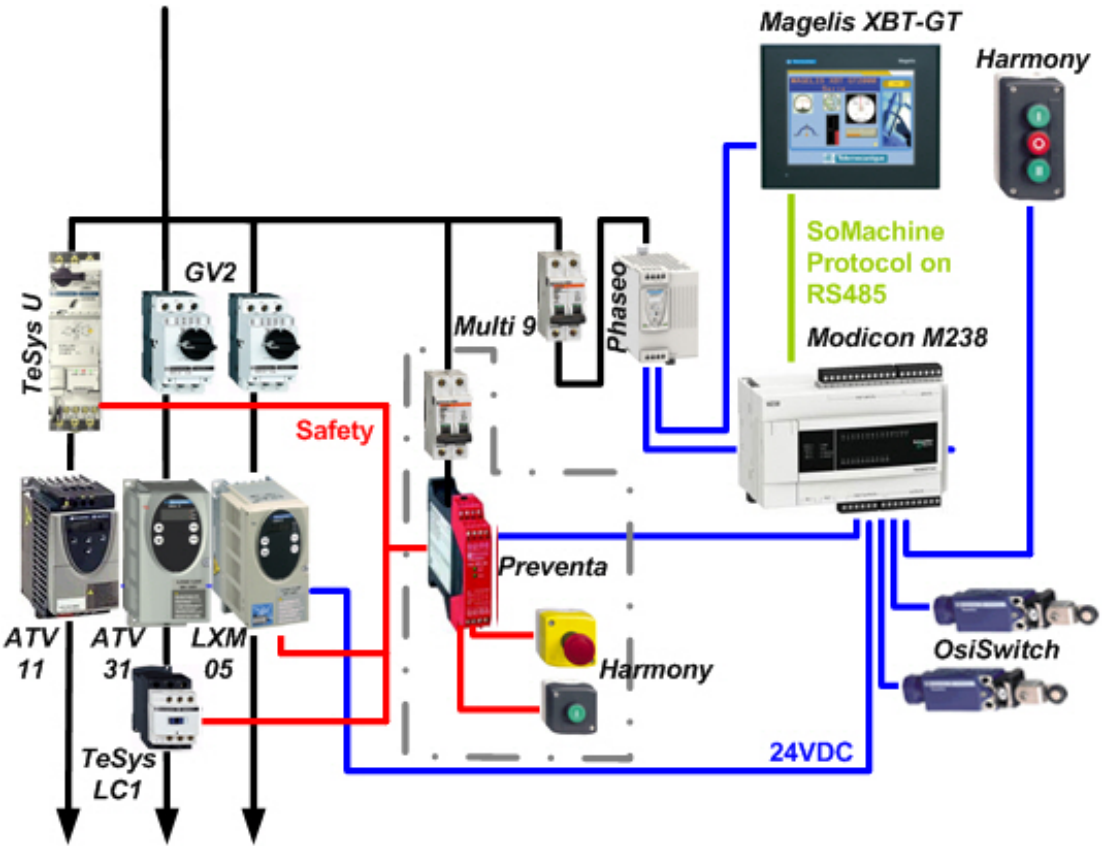
The implementation chapter describes all the steps necessary to initialise, to configure, to program and start-up the system to achieve the application functions as listed below.

Function

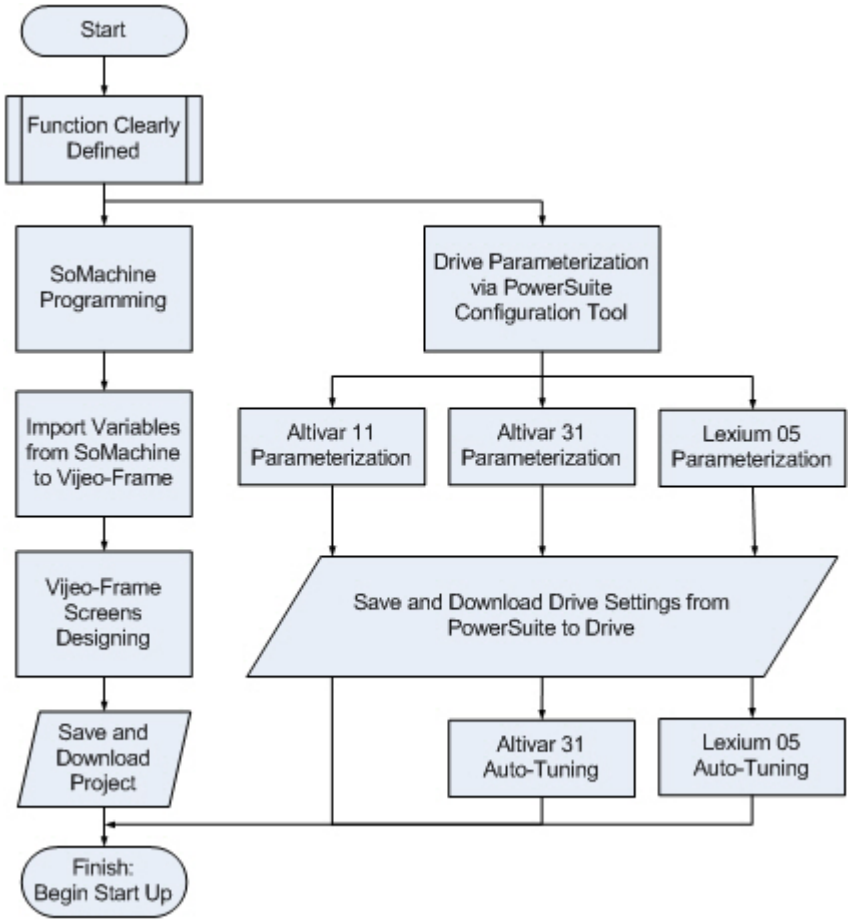
Start-up and functional description:

1. Switch on all fuses and contactors.
2. Reset the emergency stop.
3. Switch on at master switch.
4. Acknowledge the emergency stop by pressing the blue illuminated push button.
5. Wait for the red and blue lights of the illuminated push buttons to turn off.
6. On the HMI screen called SYSTEM, choose to operate between local or manual mode.
7. Manual Mode: Using the screens ATV11, ATV31 and LXM05 the user can control the drives individually via the buttons FWD, REV, STOP and RESET. The user can also adjust the individual manual speeds.
8. Local Mode: Control the drives from the selector switch that is mounted on the outside of the cabinet. Reset drive detected faults by acknowledging the red illuminated push button. Using the screens ATV11, ATV31 and LXM05, adjusts the individual local drive speeds.
9. Use the SYSTEM, SAFETY and ALARM screens to monitor the status of the system, including the individual drives, the E-Stop and logged system alarms.
10. Use the XBTGT screen to configure the HMI.

Functional Layout



Course of Action



Communication

Introduction

This chapter describes the data passed via the communications bus (e.g. CANopen or Ethernet) that is not bound directly with digital or analog hardware.

The list contains:

- The device links
- Direction of data flow
- symbolic name and
- Bus address of the device concerned.

Device Links

The described architecture is a hardwired system. There is no communication bus system.

This application uses the SoMachine protocol on RS485 for the data exchange between the PLC and HMI.

The SoMachine protocol connects:

Magelis-Panel XBT-GT
Modicon M238 PLC

General Addressing

The PLC example program uses different hardware, discrete and memory words The following list contains keys to aid the understanding of the addressing system used.

Type	Address	Comment
Digital Inputs	%IXby.x	Digital inputs are hardware orientated: by as byte number, x as bit number. E.g.: Emergency Stop response at %IX0.1
Digital Outputs	%QXby.x	Digital outputs are hardware orientated: by as byte number, x as bit number. E.g.: Lamp Indicator at %QX0.1
Analog Inputs	%IWx	Analog inputs are hardware orientated: x as word number. E.g.: Actual Motor Drive Speed at %IW1
Analoge Outputs	%QWx	Analog outputs are hardware orientated: x as word number. E.g.: Motor Drive Speed Target at %QW1

PLC

Introduction

The PLC chapter describes the steps required for the initialisation and configuration and the source program required to fulfil the functions.

Requirements

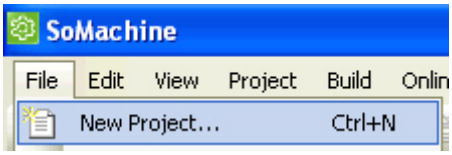
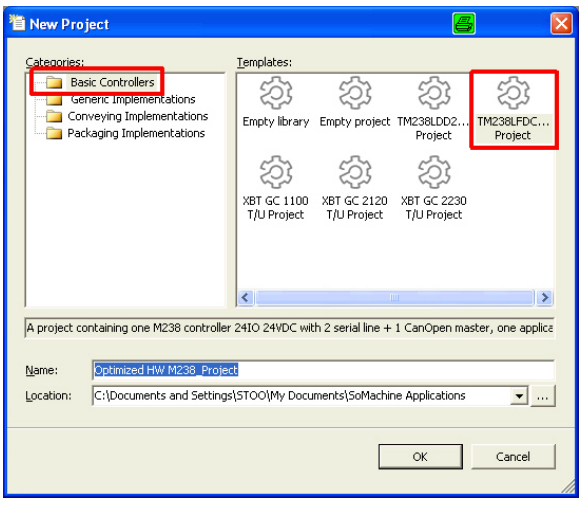
The following is required to proceed:

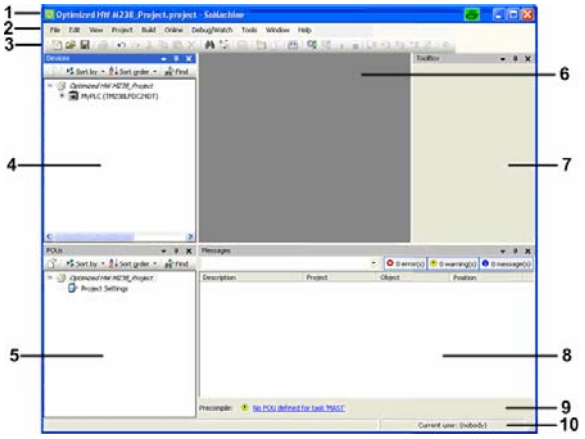
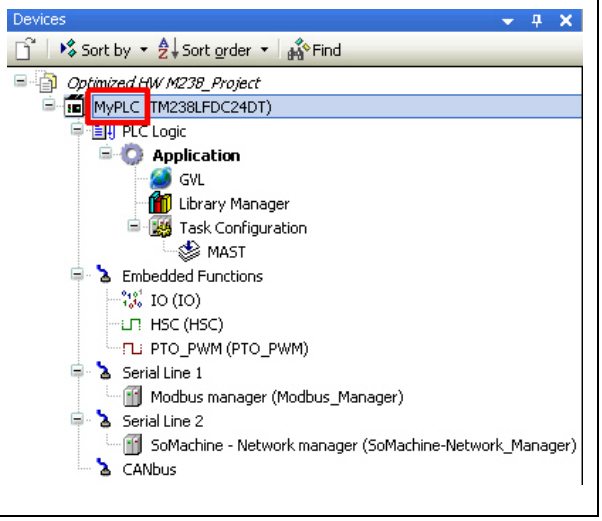
- SoMachine is installed on your PC
- The M238 PLC is switched on and running
- The PLC is connected to the HMI with the programming cable XBTZ9008 (PLC to HMI)
- The HMI is connected to the PC via the cable XBTGZ935 (HMI to PC)

Setting up the PLC is conducted as follows:

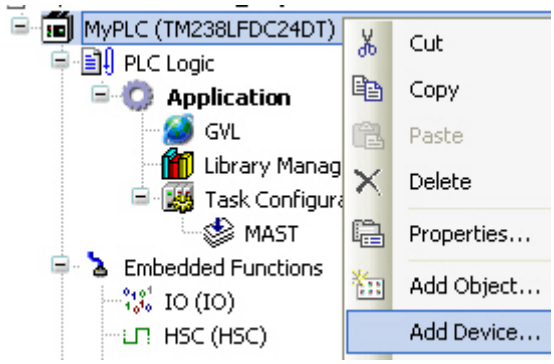
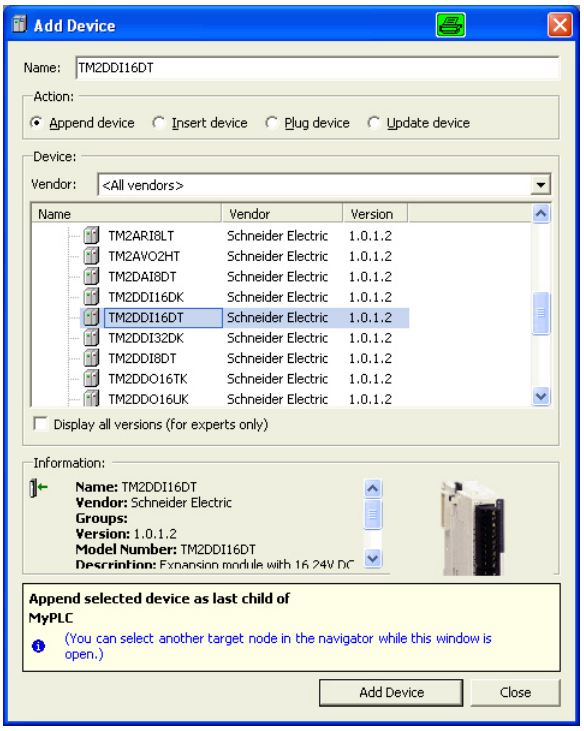
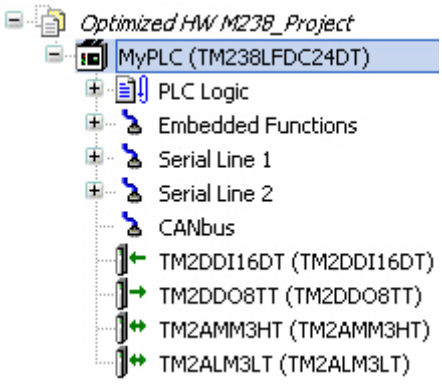
- Create a New program
- Add IO Expansion Modules
- Configure IO Expansion Modules
- Map IO Module Variables to Existing Variables
- Configure PTO Function for LXM05
- Add Toolbox Library
- Add POU
- Configure Task
- Configure PLC ↔ HMI Data Exchange
- Add Magelis HMI
- Communication Settings PLC ↔ PC
- Communication Settings PLC ↔ HMI
- Save the Project
- Build Application
- Download the PLC and HMI program
- Login to the PLC
- POU overview

Create a New program

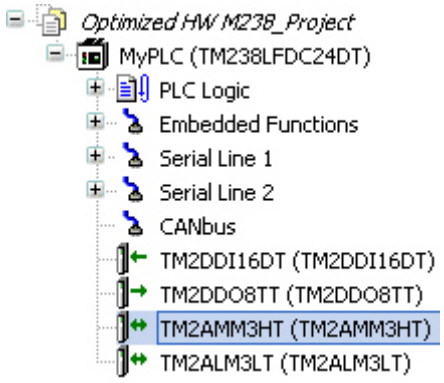
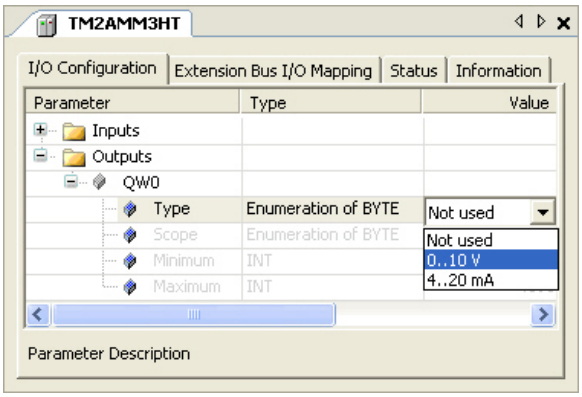
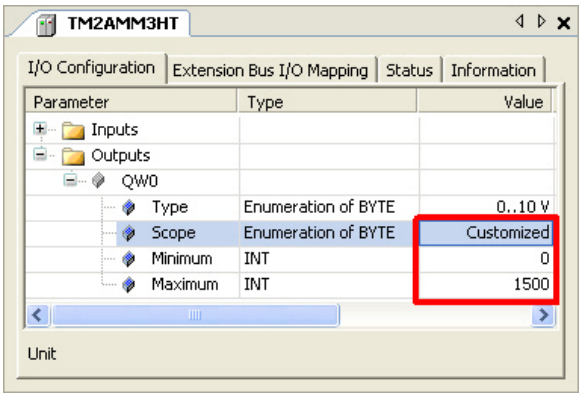
1	To create a new project, select: **File→New Project…**.	
2	In the **New Project** dialog box, select the **TM238LFDC… Project** template icon and enter a name for the project in the **Name** box. In the **Location** box, you can enter the path for saving the project file or click on the browse button **…** to search for a suitable folder. Click **OK** to confirm and close the dialog box.	

3	The new SoMachine Workspace appears. The SoMachine user interface has the following components: 1. Title bar 2. Menu bar 3. Toolbar 4. **Devices** browser 5. **POUs** browser 6. Editor 7. **ToolBox** window 8. **Messages** box 9. Information and status line 10. Status bar	
4	Using the M238 Project template, the PLC M238 controller is automatically added into the project. The **Devices** browser displays the M238 controller with the name **MyPLC**.	

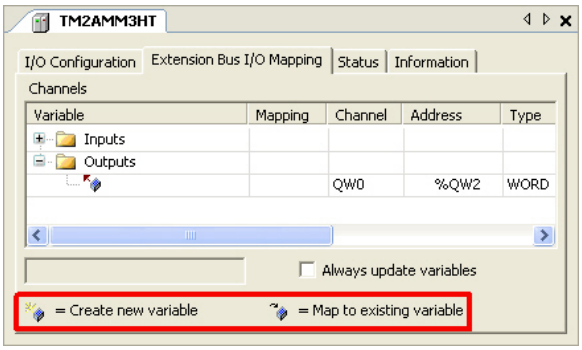
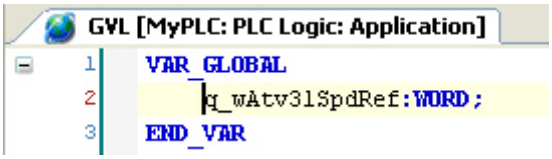
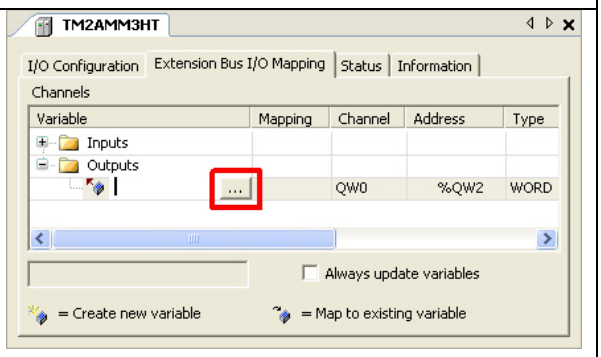
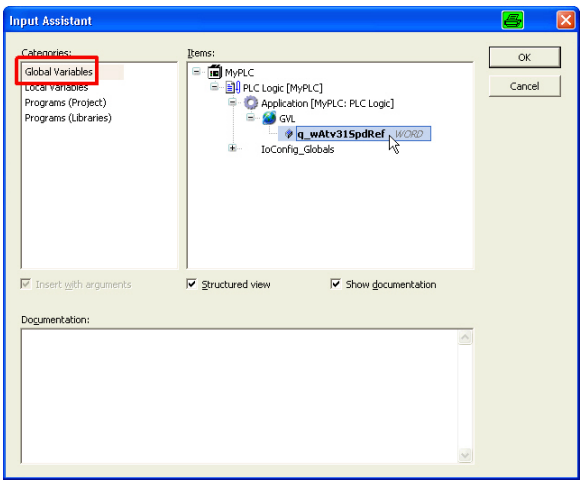
Add IO Expansion Modules

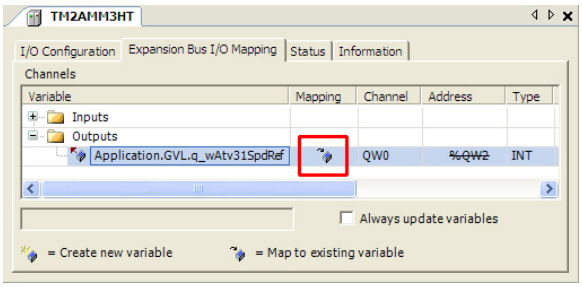
1	To add expansion modules to the PLC, right click on **MyPLC** in the Devices browser and click on **Add Device…**.	
2	In the **Add Device** dialog, select the required I/O expansion modules and click on **Add Device**. For this project, the following modules are added: **1x TM2DDI16DT** **1x TM2DDO8TT** **1x TM2AMM3HT** **1x TM2ALM3LT** When you have finished adding the modules, click on **Close**.	
3	The added expansion modules can now be seen at the end of the device list in the browser. Note: The sequence of the modules has to be consistent with the sequence of the actual hardware, i.e. in this application the TM2DDI16DT module is attached to the expansion module interface of the M238 PLC and the TM2DDO8TT module to the expansion interface of the TM2DDI16DT module.	

Configure IO Expansion Modules

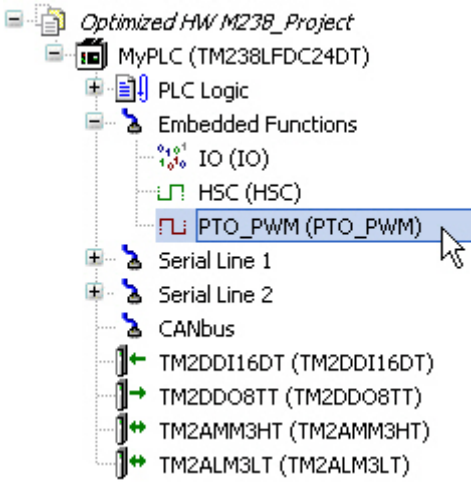
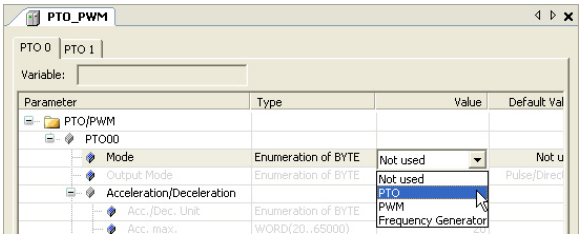
1	To configure an expansion module, double click on it in the browser. Here we will configure the analog output of the expansion module **TM2AMM3HT**.	
2	In the **I/O Configuration** tab, the **Value** of the **Enumeration of BYTE** for the **Type** of **QW0** is changed to **0..10V**. Press Enter to accept the new selection. The **Value** of the **Enumeration of BYTE** for the **Scope** of QW0 is set to **Customized**, with a **Minimum** of **0** and a **Maximum** of **1500**. Press Enter to accept each modification.	 

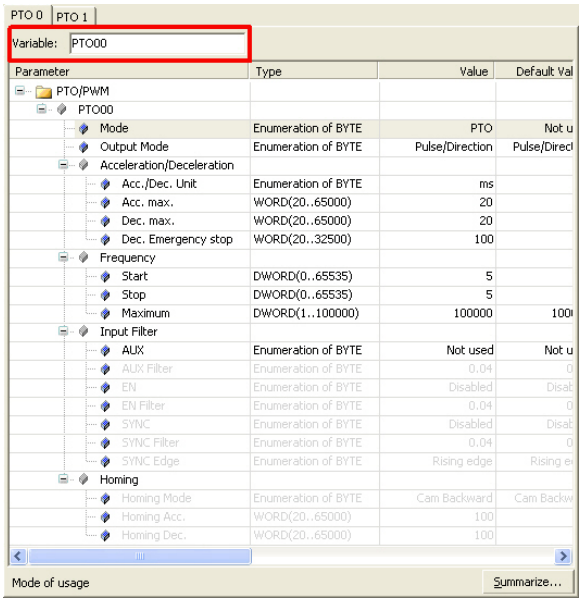
Map IO Module Variables to Existing Variables

1	On the **Extension Bus I/O Mapping** tab it is possible to map the data of **QW0** to a variable. There are two ways of Mapping: Create a new variable Mapping to an existing variable In this project, **Map to existing variable** was used, i.e. the output is mapped to an existing variable that is located in the folder **Application → GVL**. GVL stands for Global Variables List, which can be accessed throughout the **Application** folder. The GVL is opened by double clicking on **GVL** in the Devices browser. In this application, **q_wAtv31SpdRef** is declared as a WORD variable in the application's **GVL (Application.GVL.q_wAtv31SpdRef)** prior to mapping the data **QW0** to it.	 
2	To map the output to an existing variable, double click on the output **Variable** field then click on the **…** button that appears at the end of the field. In the **Input Assistant** dialog that opens, locate the variable inside the **Global Variables** category and select it. Then click on **OK**.	 

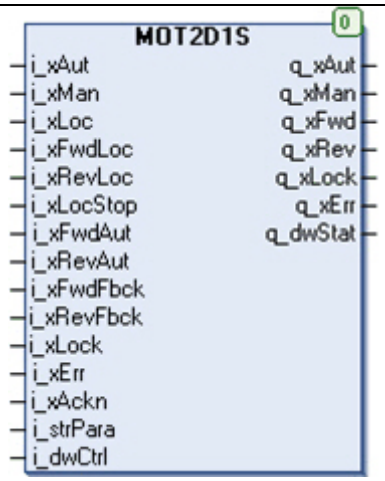
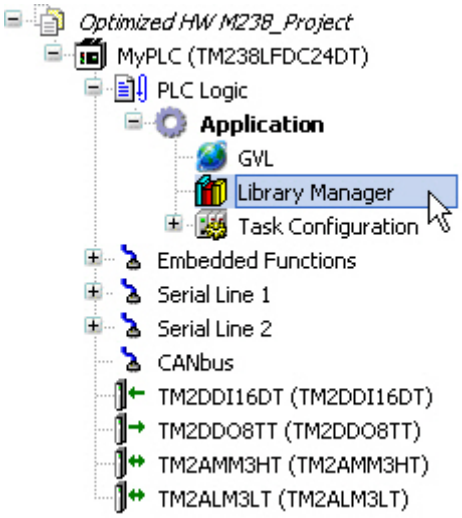
3	The analog module's output WORD, **QW0**, now maps itself to **Application.GVL.q_wAtv31SpdRef**. To refresh all the I/O variables in every cycle with the latest I/O data, check the **Always update variables** box. If left unchecked, only the status of the I/O variables that are called in the POUs are updated.	

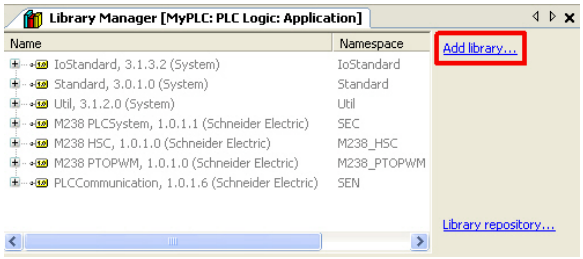
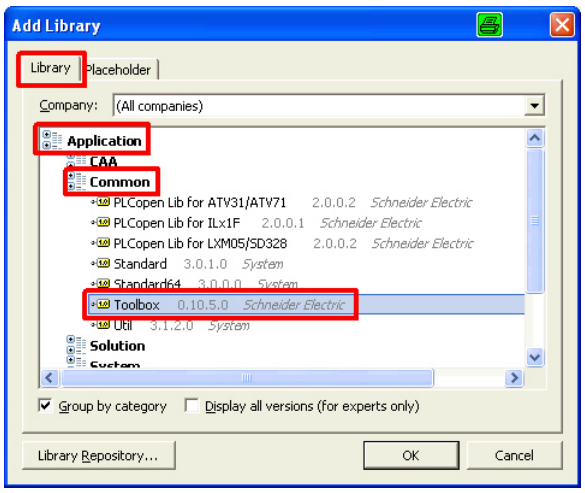
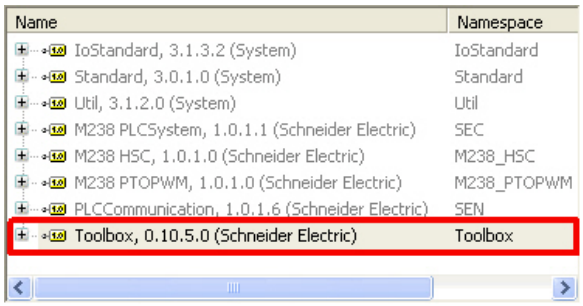
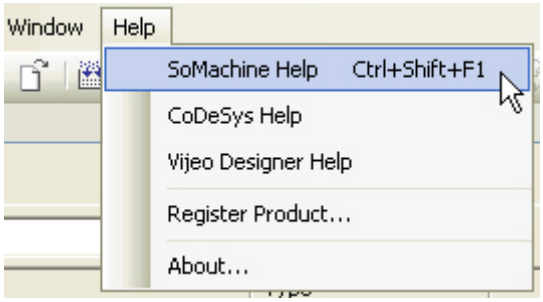
Configure PTO Function for LXM05

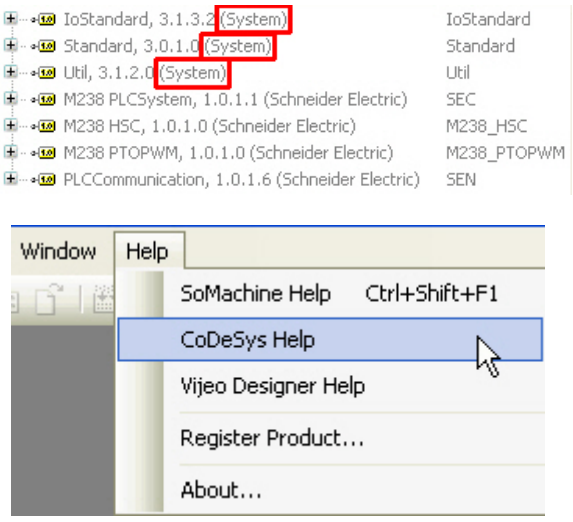
1	To configure the PTO function, double click on **Embedded Functions → PTO_PWM** in the Device browser.	
2	In the **PTO 0** tab, the **Value** of the **Enumeration of BYTE** for the **Mode** of **PTO00** is changed to **PTO**.	

3	By default, the **PTO 0** output of the M238 controller is mapped to a **Variable** called **PTO00**. In this application, the **PTO 0** default settings are used.	

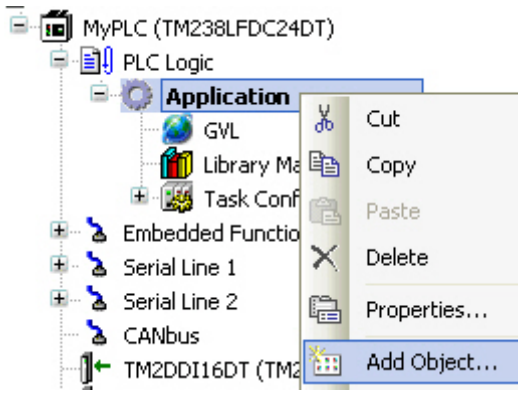
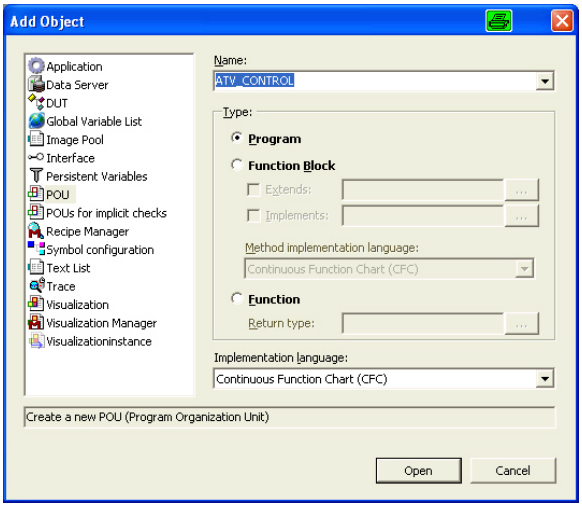
Add Toolbox Library

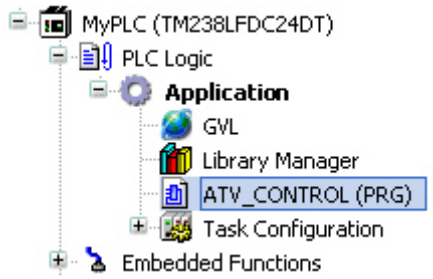
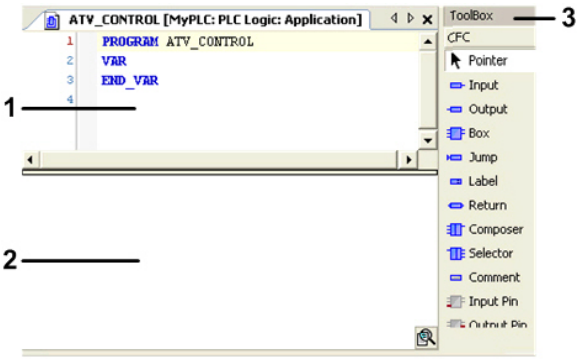
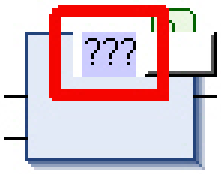
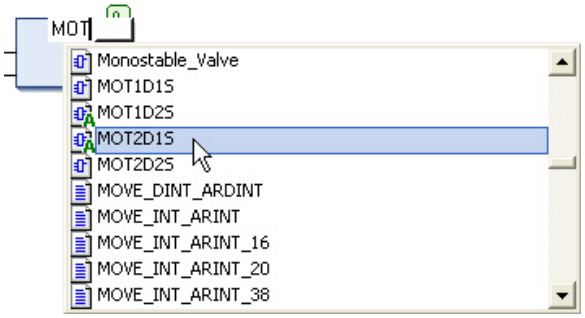
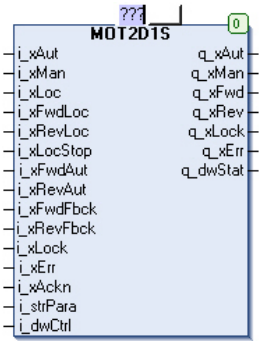
1	In this example application, the function block **MOT2D1S** is used to manage the forward and reverse control of the ATV11, ATV31 and LXM05 drives. This function block is in the Toolbox library.	
2	The current libraries in the project can be viewed in the **Library Manager**. Double click on **Library Manager** in the Devices browser to open the Library Manager.	

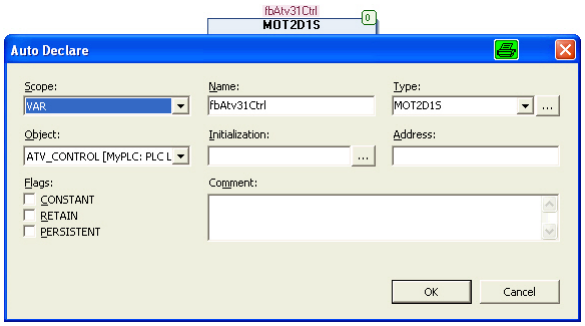
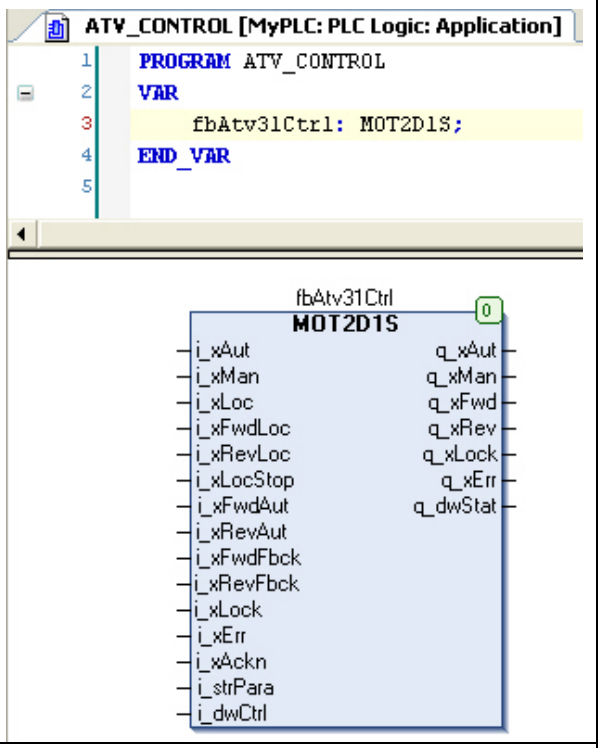
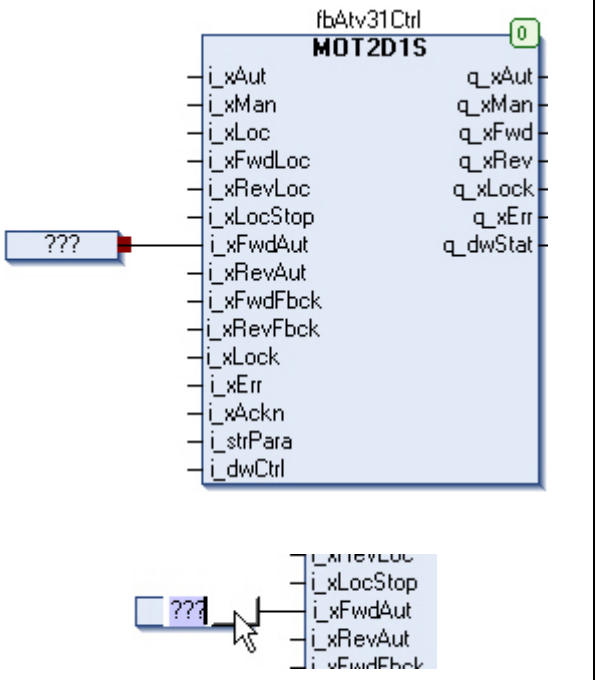
3	To add the Toolbox library, click on **Add library…** in the **Library Manager** editor.	
4	In the **Add library** dialog, on the **Library** tab, select: **Application →** **Common →** **Toolbox** And click on **OK** to insert the **Toolbox** library into the Library Manager.	
5	The new library can now be seen in the Library Manager editor list.	
6	More information on the Toolbox library, its modules and other Schneider Electric libraries can be found in the **SoMachine Help** under the **Help** menu.	

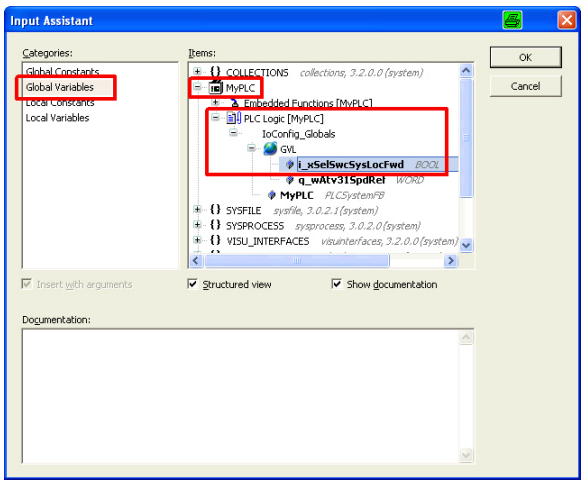
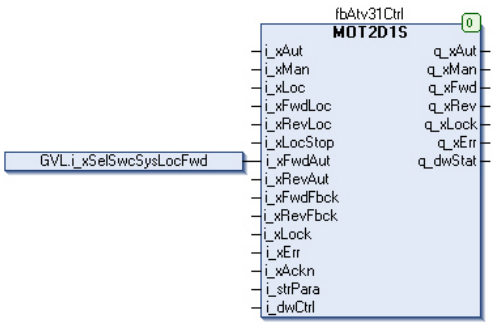
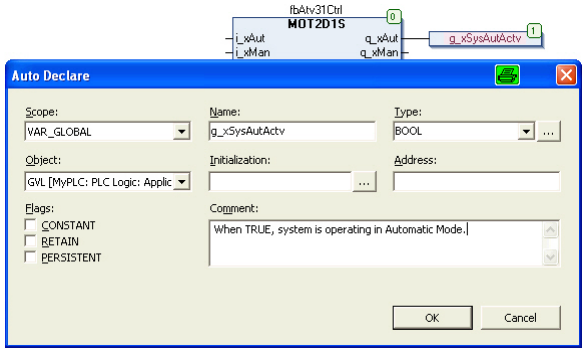
7	Information on **System** libraries and their modules can be found in the **CoDeSys Help** under the **Help** menu.	
8	Repeat steps 2 to 4 to add more libraries.	

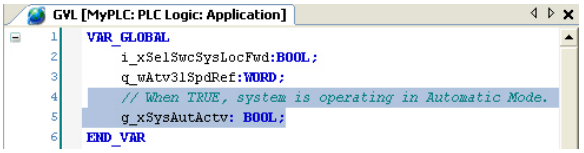
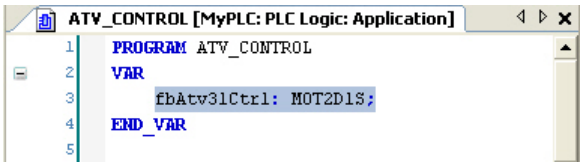
Add POU

1	To add a POU to the project, right click on **Application** in the Devices browser and select **Add Object…** in the pop-up menu.	
2	In the **Add Object** dialog, select **POU** and enter a **Name**. Select **Program** as the **Type** and CFC as the **Implementation language**. It is possible to select any of the IEC languages and to generate functions and function blocks. Click on **Open** to continue.	

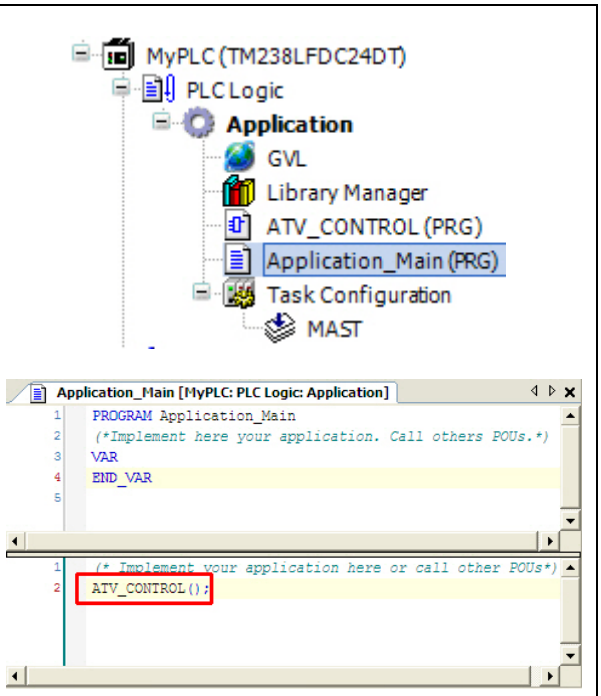
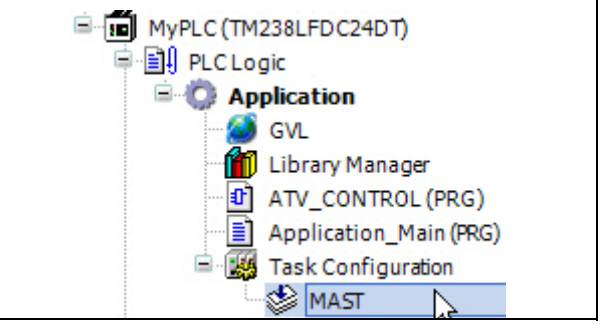
3	The new POU **ATV_CONTROL** is now visible in the Devices browser under the **Application** entry.	
4	The tab **ATV_CONTROL** is opened in the Editor. It is divided into the following sections: 1. Declaration section 2. Programming section 3. **ToolBox** – use drag and drop to place programming elements in the programming section	
5	Begin by placing a box element in the programming section. Then click on the **???** field.	
6	Type in a name for the function or function block. When you start to type a hint list opens. In this project, the MOT2D1S FB is used for controlling the forward and reverse commands of the drives. Select **MOT2D1S** from the list and press Enter twice.	
7	To instantiate the FB, click on **???** at the top of the template. Type in a name (for example fbAtv31Ctrl) and press Enter.	

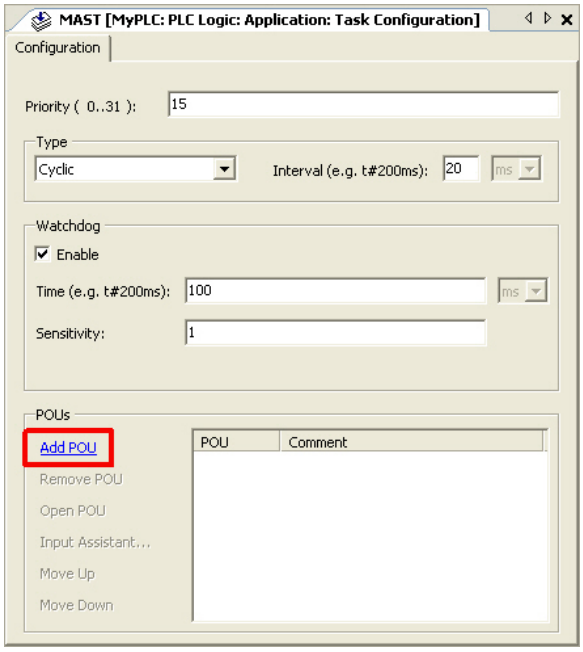
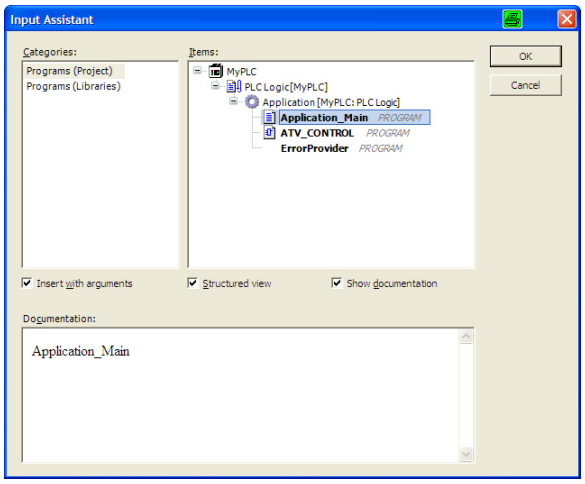
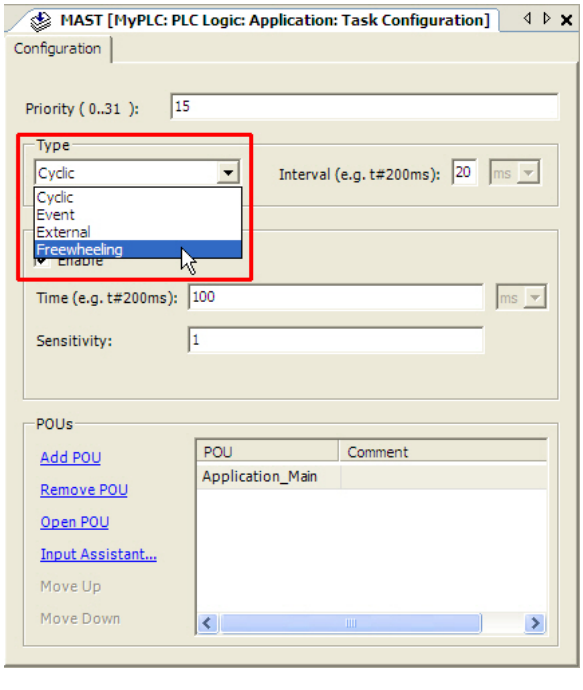
8	The **Auto Declare** dialog opens. A variable comment can be added in the **Comment** box**.** Click **OK** to create the instance.	
9	The new FB **MOT2D1S** is instantiated in the declaration section of the **ATV_CONTROL**.	
10	To connect a variable to an input, place an input element from the ToolBox on the input side of the FB and connect the input box to an FB input by clicking on the red end and dragging it to the input of the FB. To open the Input Assistant dialog: Click on **???** in the input box and press **F8** Or, alternatively: Click on the white box that appears at the end of the field.	

11	In the **Input Assistant** dialog, select **Global Variables** in the **Categories** list. In the **Items** section, select: **MyPLC →** **Plc Logic →** **Application →** **GVL** and then the variable. In this project, the variable is a three-position selector switch that is mapped to a global variable. Click on **OK**.	
12	This image shows the FB with the connected input.	
13	Connecting a variable to an output is done similar to the input, but here, a new variable is created. Click on the **???** in the output field, type in a name for the variable and then press Enter. In the **Auto Declare** dialog that opens, select the **Scope** and **Type** and confirm the variable **Name**. In this example, select **VAR_GLOBAL** and **BOOL** from the **Scope** and **Type** list box respectively. When finished, click on **OK**.	

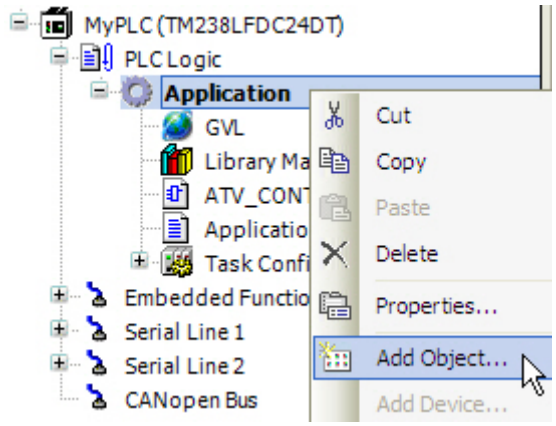
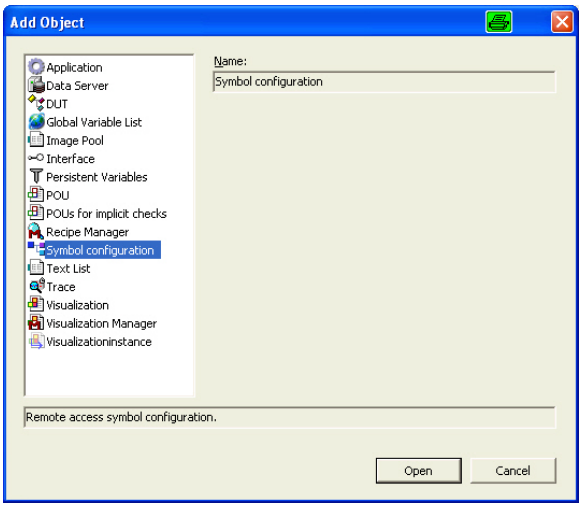
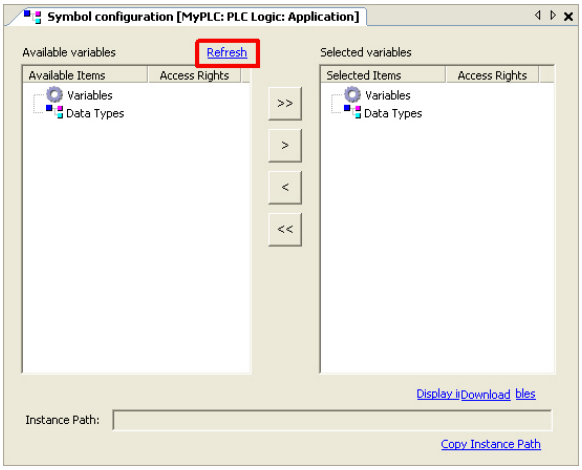
14	The **VAR_GLOBAL** variables are located in the **GVL** folder. All variables located in this folder are globally accessible and can be accessed throughout the application. If the variables are located in the POU, they can only be accessed by the POU (local variables).	 **Global Variables (Application Specific)**  **Local Variables (POU Specific)**

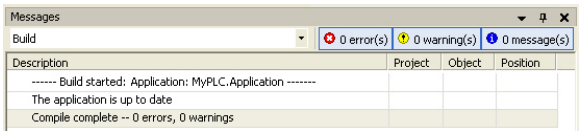
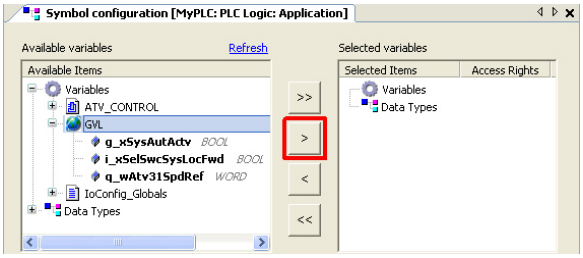
Configure Task

1	The **Task Configuration** in the Devices browser defines one or several tasks for controlling the processing of an application program. To start working with a new POU, it has to be called within a Task. In this application, all POUs are implemented by the POU **Application_Main**, which is added to the **MAST** task. To do this, first add a POU called **Application_Main** and call the POUs from here. In this application, the POU called is **ATV_CONTROL**.	
2	Double click on **MAST** task.	

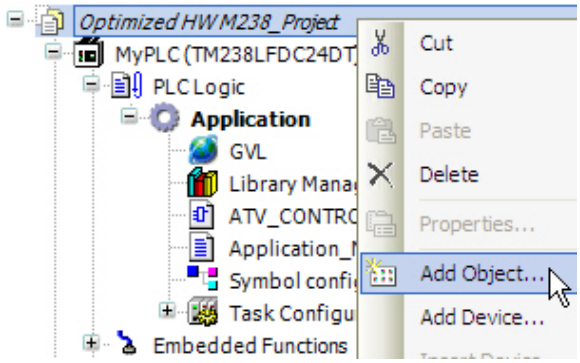
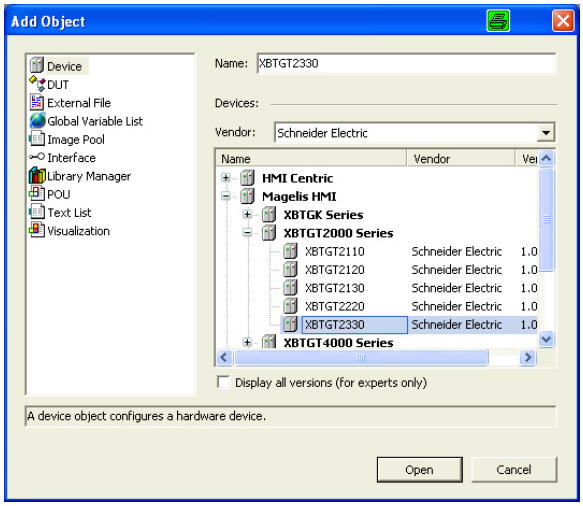
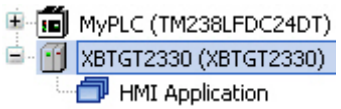
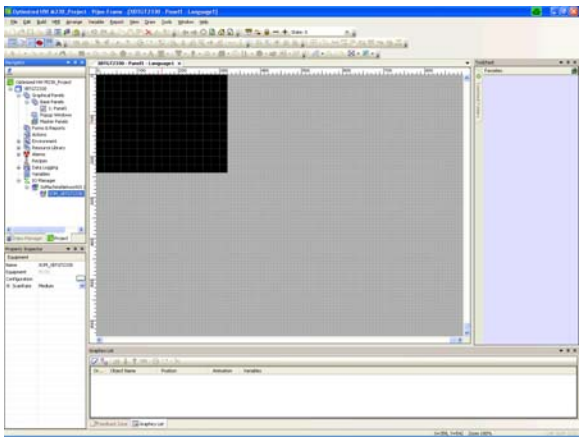
3	In the **MAST** tab, click on **Add POU**.	
4	In the **Input Assistant** dialog, select **Programs (Project)** in the **Categories** list and select the POU in the **Items** list. In this application, the POU is **Application_Main**. Click on **OK** to confirm. **Note:** POUs that are added to the MAST task are called every cycle.	
5	The POU is now included in the **MAST** task. The **Type** of task can be modified. For this project, select **Freewheeling**.	

Configure PLC ↔ HMI Data Exchange

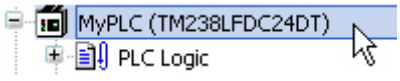
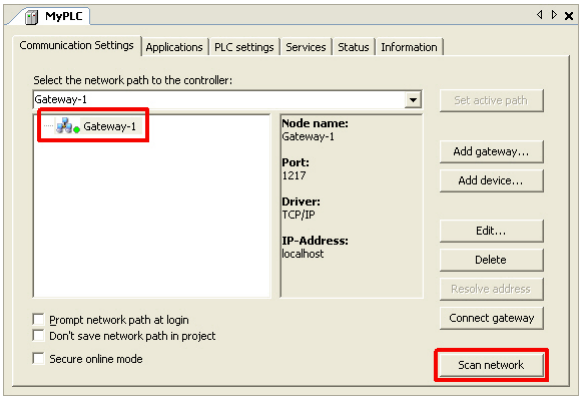
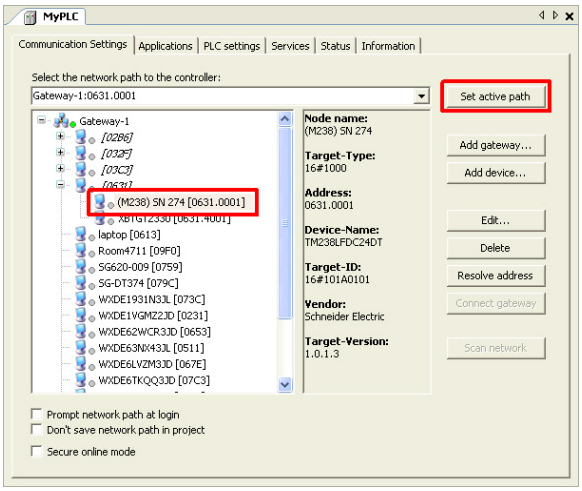
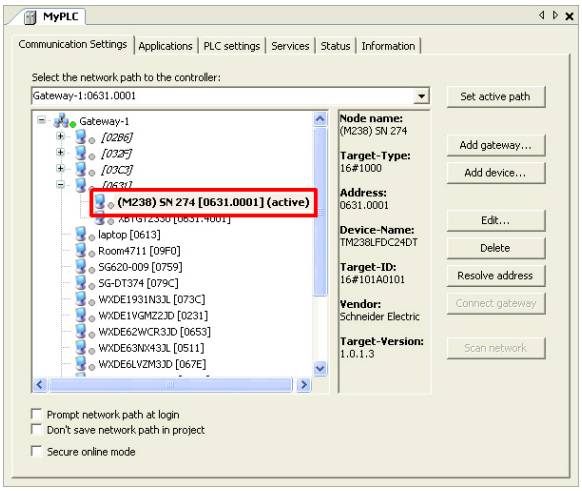
1	The object *Symbol configuration* is used to link the variables between the controller and the HMI. To add a Symbol configuration, right click on **Application** in the Devices browser and select **Add Object…** in the pop-up menu.	
2	Select **Symbol configuration** in the **Add Object** dialog**.** Click on **Open**.	
3	In the opened **Symbol configuration** tab, click on **Refresh**. The refresh invokes a compile of the program.	

4	Check the **Messages** box for the compilation results and correct any alerts. To locate the alert, double click on the message. There are no alerts in this project. Note: The Symbol configuration cannot be refreshed when there are alerts in the program.	
5	All Variables created in the user program are shown in the **Variables** list. In this project, as all variables are global variables, they are located in the GVL folder. To link the variables from the PLC to the HMI, select **GVL** and click on **>**.	
6	The right frame now lists the **Selected variables** that have been linked and can be used in the HMI.	

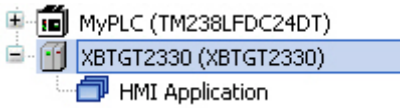
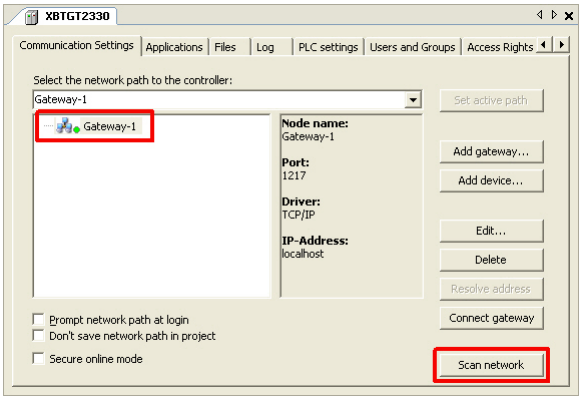
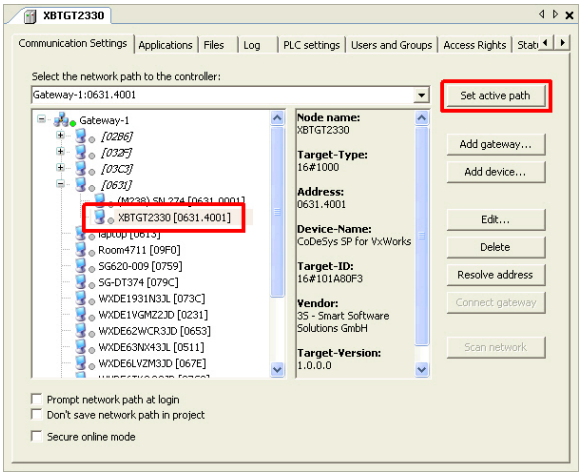
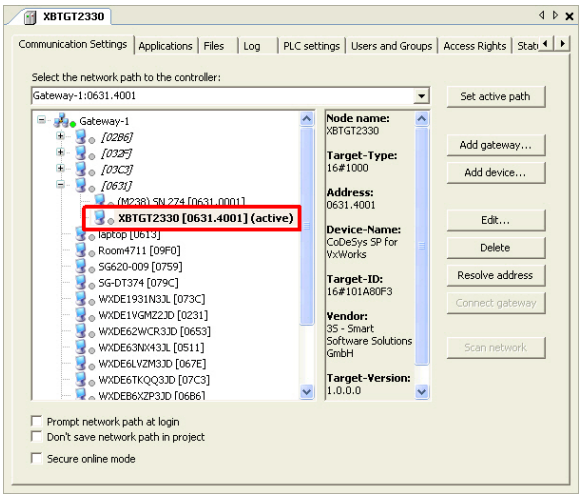
Add Magelis HMI

1	To add a Magelis HMI unit to the project, right click on the project name and select: **Add Object…** from the pop-up menu. In this project, the selection is: **Optimized HW M238_Project-> Add Object…**	
2	In the **Add Object** dialog, select **Device** and select **Schneider Electric** as **Vendor.** Click on: **Magelis HMI →** **XBTGT2000 Series →** **XBTGT2330** Click on **Open**.	
3	The new **XBTGT2330** is now listed under the project in the Devices browser. Note: When a Magelis HMI is added to a project, the HMI designing environment Vijeo-Frame opens in a new window and you can start designing HMI screens. (See the HMI Chapter)	 

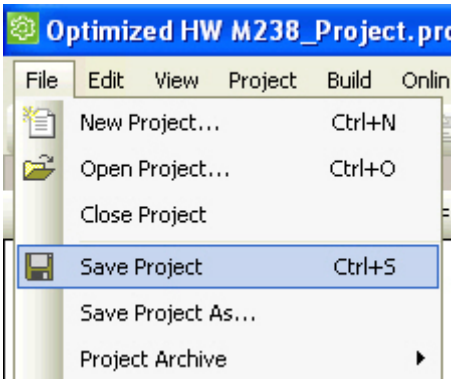
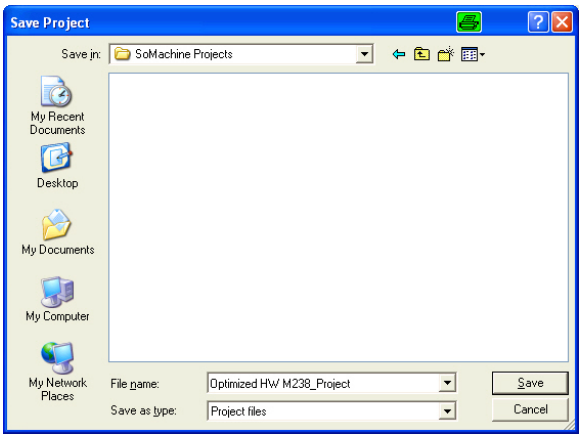
Communication Settings PLC ↔ PC

1	To configure the communication gateway, double click on **MyPLC** in the Devices browser.	
2	Select **Gateway-1** and click on **Scan network**. Note: Confirm that the PLC is connected to the PC via the HMI.	
3	During the scan, the **Scan network** button is inactive. When the scan is finished, the **Scan network** button becomes active again and the devices that have been detected are listed under **Gateway-1**. Select the PLC that is being used and click on **Set active path**.	
4	The PLC is now shown in bold and marked (**active)**.	

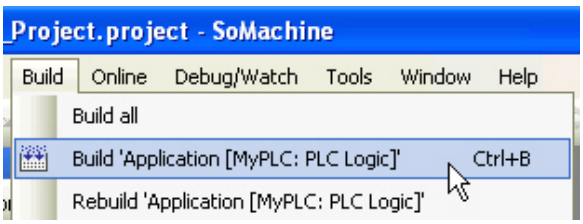
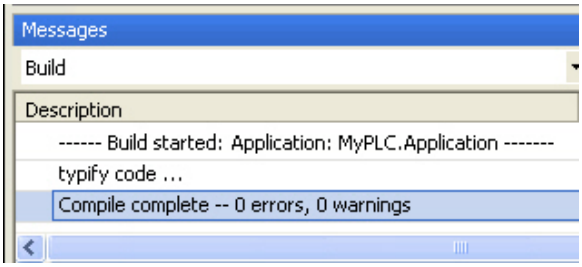
Communication Settings HMI ↔ PC

1	To configure the communication gateway double click on: **XBTGT2330**.	
2	Select **Gateway-1** and click **Scan network**. Note: Confirm that the HMI is connected to the PC.	
3	During the scan, the **Scan network** button is inactive. When the scan is finished, the **Scan network** button becomes active again and the devices that have been detected are listed under **Gateway-1**. Select the HMI that is being used and click on **Set active path**.	
4	The HMI is now shown in bold and marked **(active)**.	

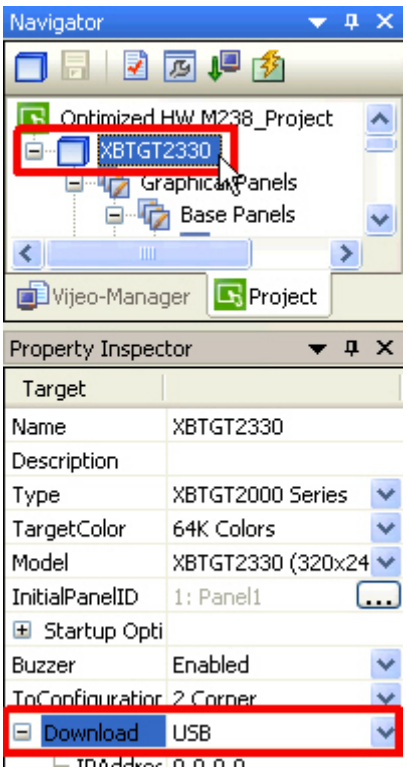
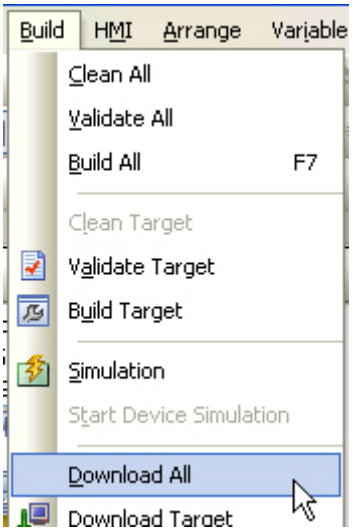
Save the Project

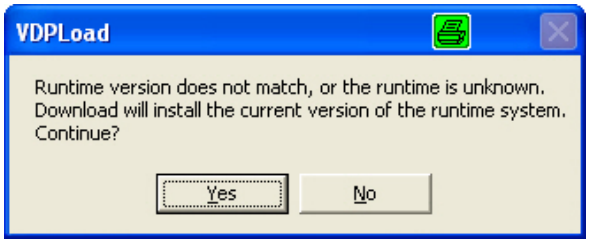
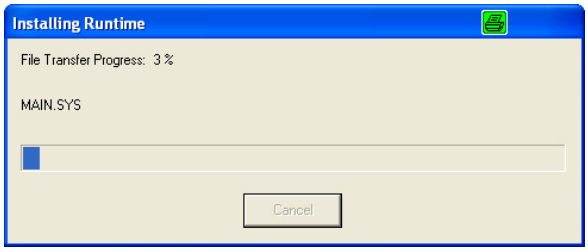
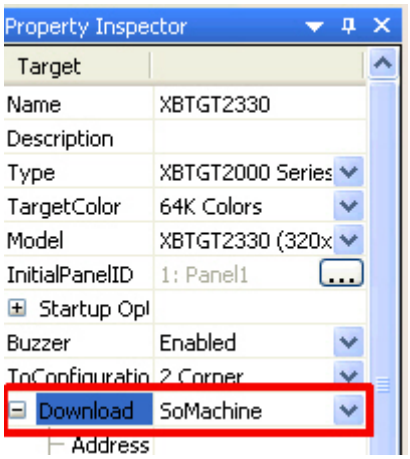
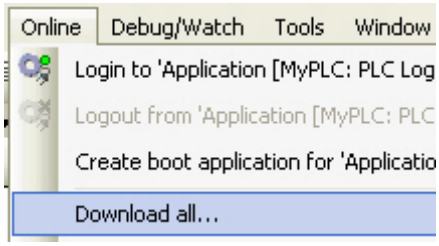
1	To save the project, click **File→Save Project** To save the project under a different name, click **File→Save Project As…**	
2	In the **Save Project** dialog that opens after clicking on **Save Project As…**, enter the new **File name** and click on **Save**.	

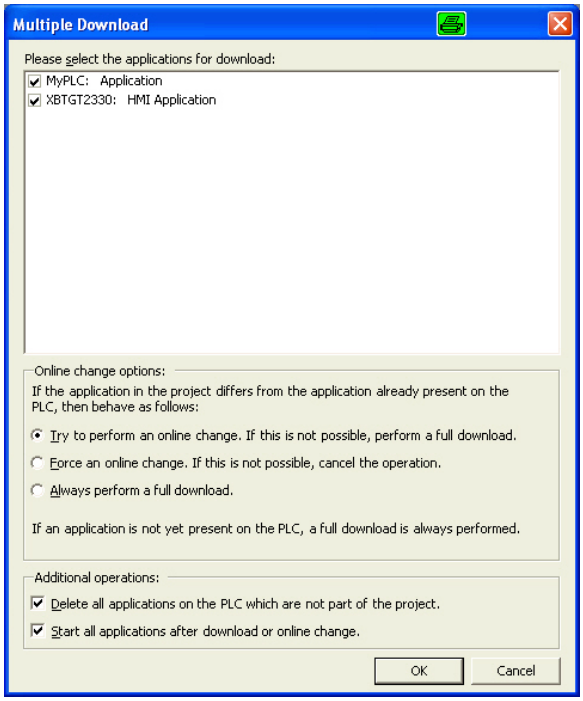
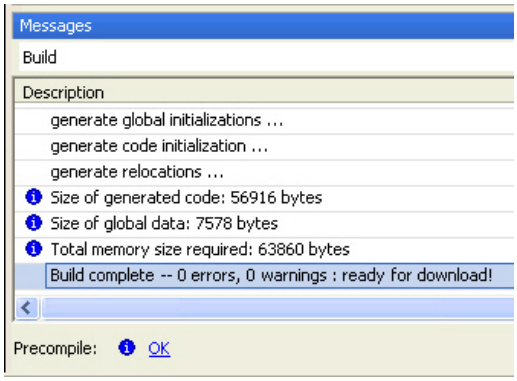
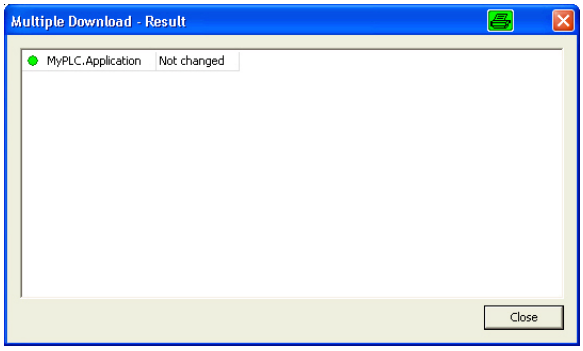
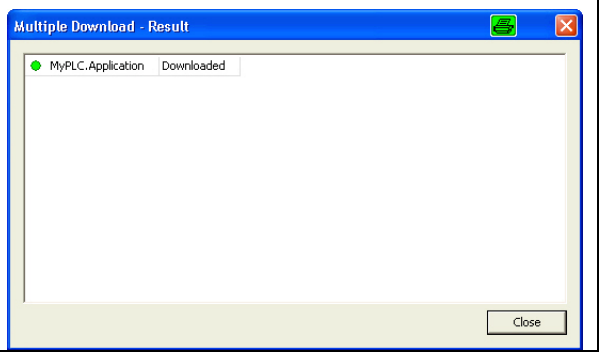
Build Application

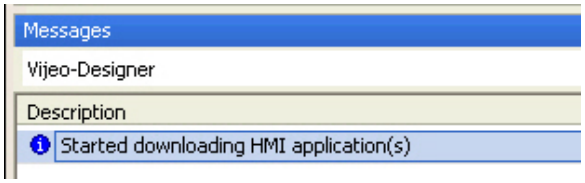
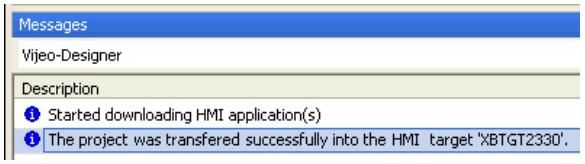
1	To build the application, click on **Build→** **Build 'Application [MyPLC: PLC Logic]'** Note: To build the whole project (both HMI and PLC) click **Build all**.	
2	After the build, the **Messages** box indicates whether the build was successful or not. If the build was not successful, the compilation alerts are listed in the **Messages** box.	

Download the PLC and HMI projects

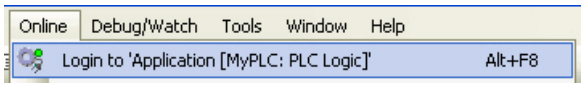
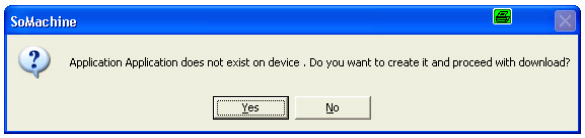
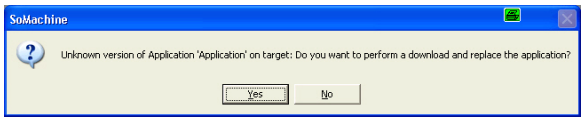
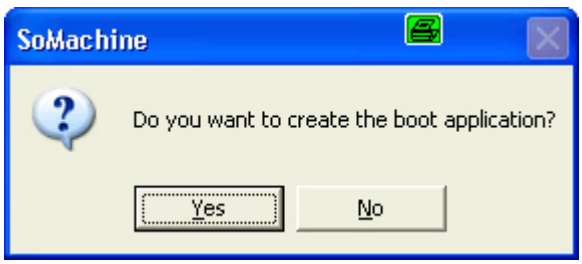
1	**Note** If it is the initial download of an application to the HMI, a download of the latest runtime version to the HMI using Vijeo Designer will be required prior to downloading the application file. This first download is described in the following steps. If this is not the first download go directly to step 7.	
2	In Vijeo Designer, select the target name in the **Navigator** to display its properties in the **Property Inspector**. In the **Property Inspector**, select **Download** via **USB**. Note: The PC must be connected to the HMI via the cable XBTZG935.	
3	Select: **Build→Download all**	

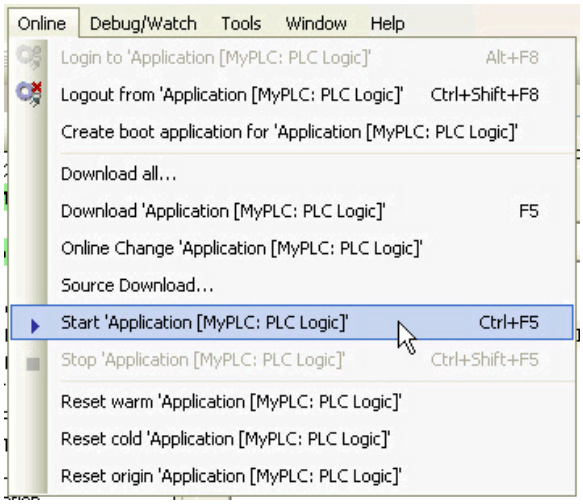
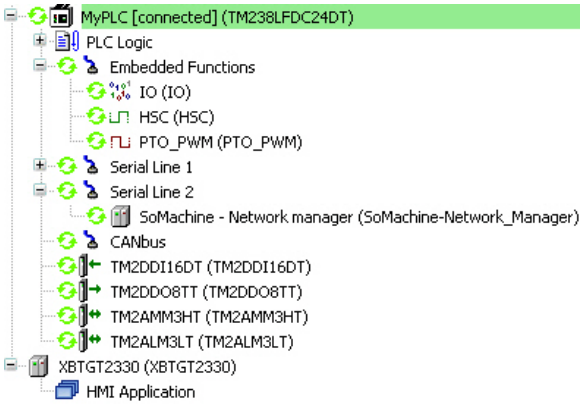
4	The **VDPLoad** dialog indicates that the runtime versions do not match. Start the download of the new version by clicking on **Yes**.	
5	The actual status of the download is displayed in a progress bar.	
6	After the runtime download, change the **Download** connection in the **Property Inspector** back to **SoMachine.**	
7	To download the application to the PLC and the HMI click **Online→Download all…**	

8	Check the boxes for the PLC (**MyPLC: Application**) and the HMI (**XBTGT2330: HMI Application**) and click on **OK**.	
9	Before the download starts, a build of the complete project is done. The result of the build is displayed in the **Messages** box.	
10	The results of the download to the PLC are displayed in the **Multiple Download – Result** window**.** Here are two examples: In the first dialog, there was no change. In the second dialog, the application was downloaded. Click on **Close** to close to the results window**.**	 

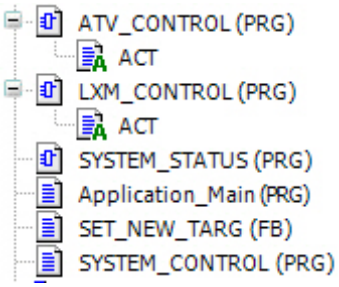
11	Once the download to the PLC is finished, the HMI application file download starts.	
12	The result of the HMI download is displayed in the **Messages** box.	

Login to PLC

1	To login to the PLC click **Online→ Login to 'Application [MyPLC: PLC Logic]'**	
2	SoMachine displays a message according to the state of the PLC you are trying to log in to. Here are two examples: In the first dialog, there is no program in the device. In the second dialog, the PLC program is different to the program on the PC. In both cases, you are asked to confirm whether to proceed with the download of the PC program into the PLC. If you do not wish to overwrite the PLC program, skip to step 6, otherwise click **Yes** to confirm the download.	 
3	The actual download status is displayed at the bottom left of the main window.	
4	Here you can choose to create a boot project if you wish. A boot project is stored in EPROM so that a power loss on the PC does not mean you have to repeat the download before re-starting. Select **Yes** to create a boot application.	
5	The actual creation status is displayed at the bottom left of the main window	

6	To start running the application in the PLC, choose **Online →** **Start 'Application [MyPLC: PLC Logic]'**	
7	If there are no detected alerts, the devices and folders are marked in green, otherwise they are marked in red.	

POU overview

1	The picture on the right shows the structure of the program. The function block MOT2D1S that is used in this application in POU **ATV_CONTROL** and **LXM_CONTROL** has its own entry in the structure and require an action (indicated with an A on the icon). These actions are, for example, used to manage the changeover delay from a forward to a reverse command, etc.	

HMI

Introduction

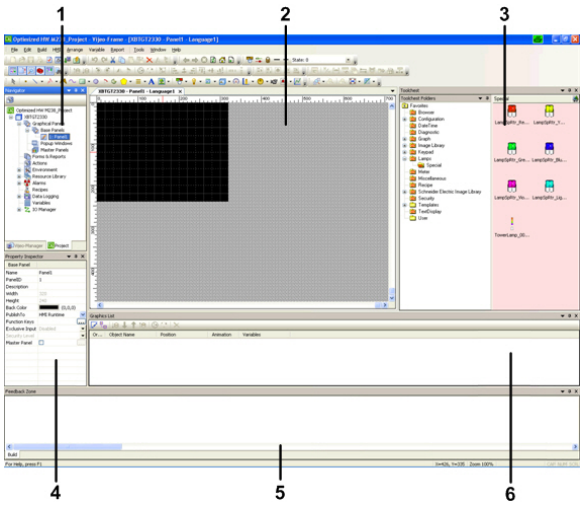
This application uses a Magelis XBT-GT2330 HMI. This device communicates with the PLC using SoMachine protocol on RS485. The Magelis is programmed using the software tool **Vijeo Designer** (Delivered with SoMachine) that is described in brief in the following pages. For the connection between the PLC and the HMI, the cable **XBTZ9008** is used.

NOTE:
The Vijeo-Frame is invoked via SoMachine. For more information see chapter **PLC: Add Vijeo Designer HMI**

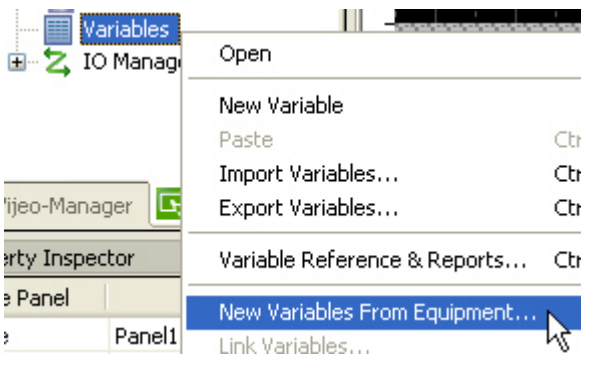
Setting up the HMI is done as follows:

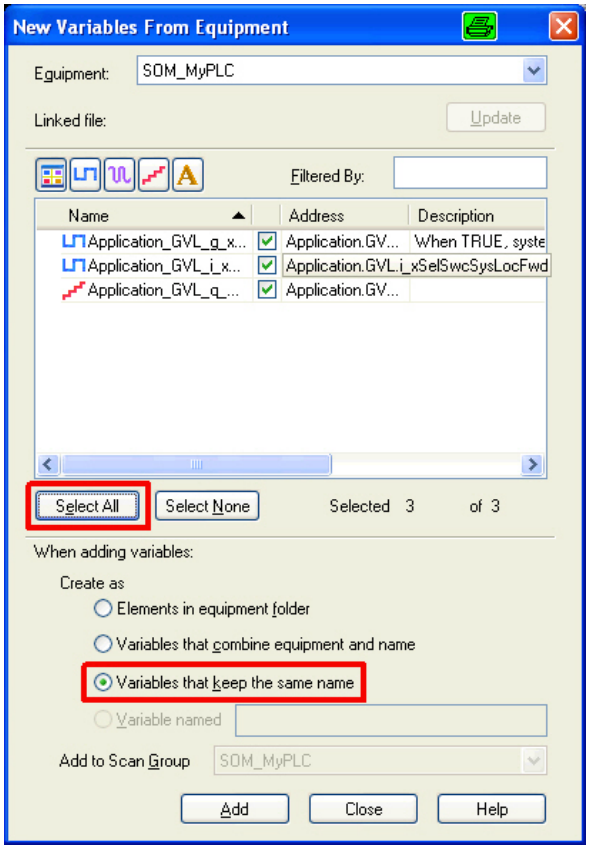
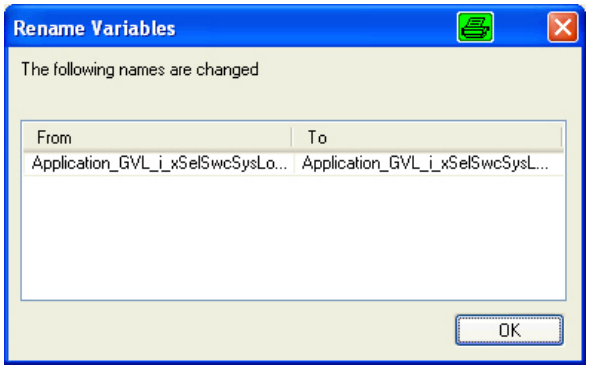
- Main Window
- Import the SoMachine variables
- Communication Settings HMI ↔ PLC
- Create a Switch
- Create a Numeric Display
- Example Screens

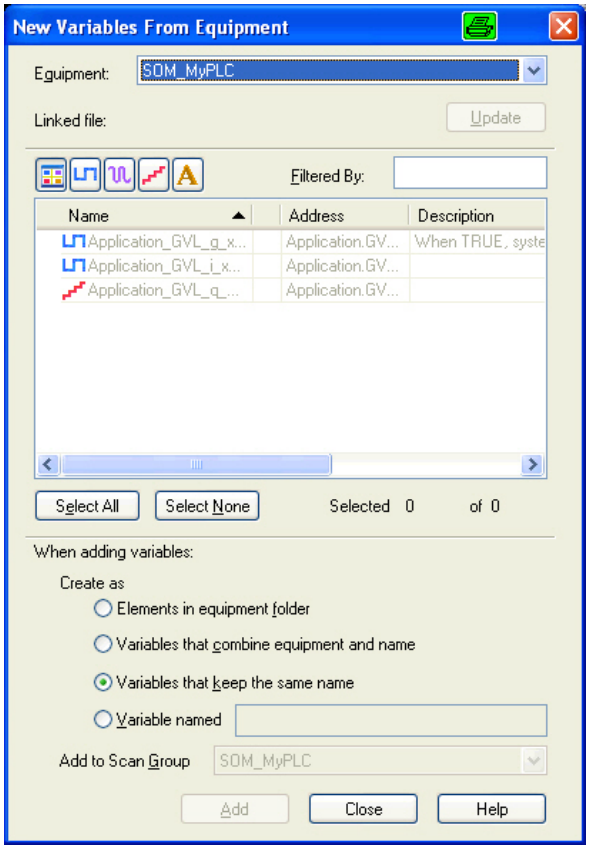
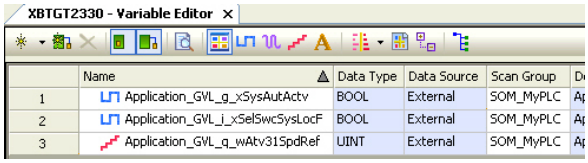
Main Window

1	After creating a Vijeo Designer HMI program in SoMachine the main window of Vijeo Designer is displayed. Vijeo Designer has the following components: 1. Navigator 2. InfoViewer 3. Toolchest 4. Property Inspector 5. Feedback Zone 6. Graphic List	

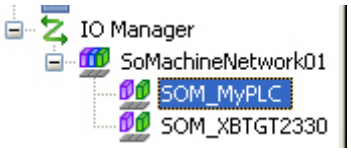
Import the SoMachine variables

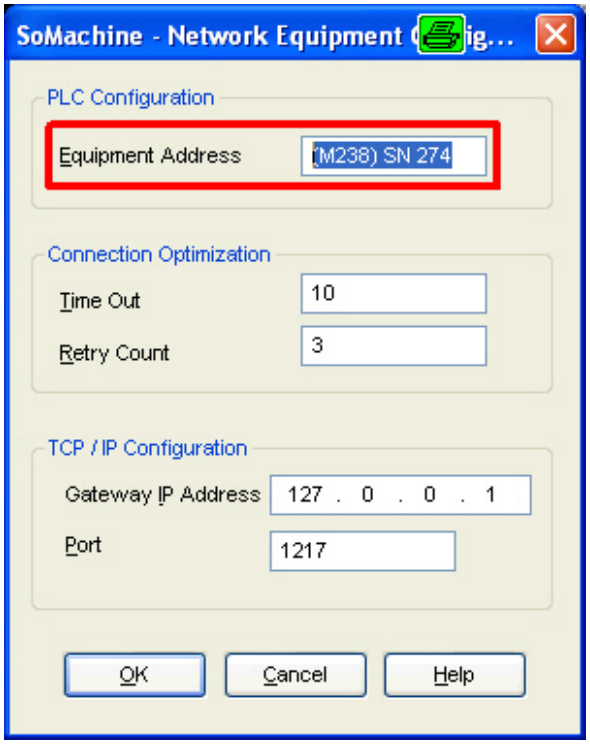
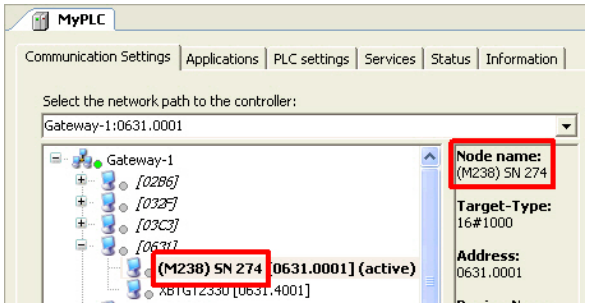
1	To import the variables, right click on **Variables** in the Navigator and select **New Variables From Equipment...** in the pop-up menu.	

2	In the dialog **New Variables From Equipment**, select either the variables that you require by checking their respective boxes or click the **Select All** button. Select **Variables that keep the same name** and click on **Add**.	
3	If the length of the variable name exceeds 32 characters, you are notified that the variable name(s) have been truncated to 32 letters. Click on **OK**. Note: The naming convention in Vijeo Designer is limited to 32 characters.	

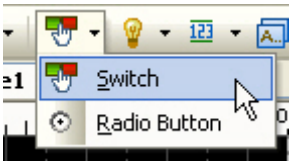
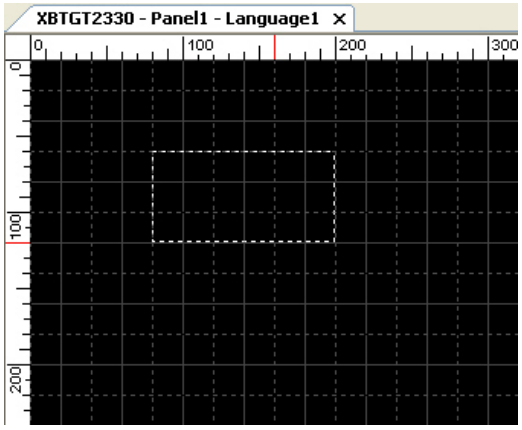
4	In the dialog **New Variables From Equipment**, the variables that have been added to Vijeo Designer are shown as inactive. Click on **Close** to close the dialog.	
5	Click on Variables in the Navigator to view the list of variables that have been imported.	

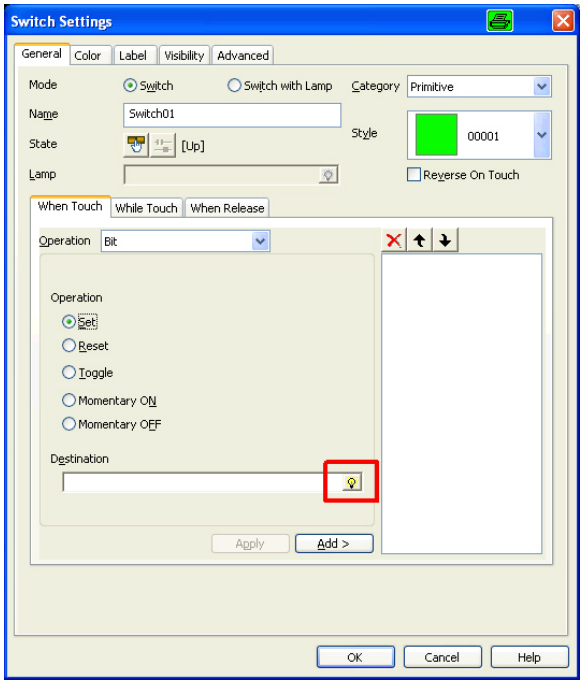
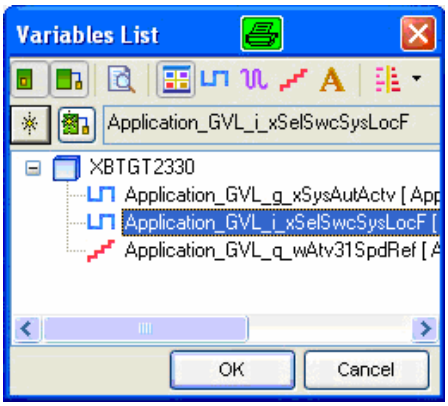
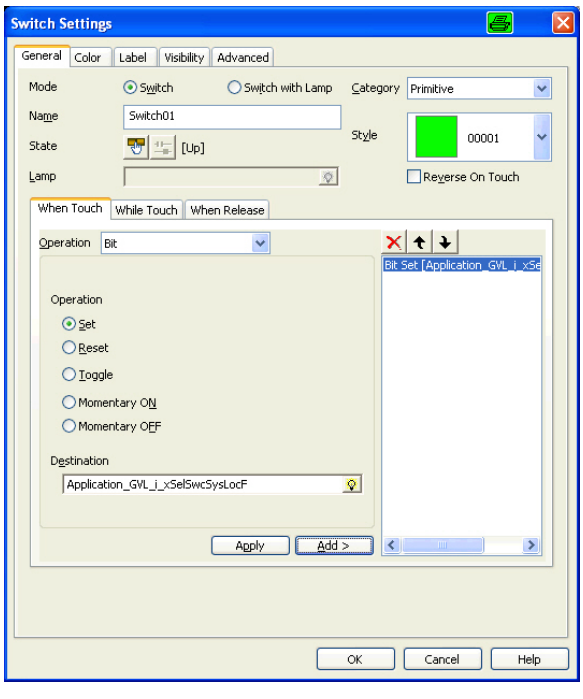
Communication Settings
HMI ↔ PLC

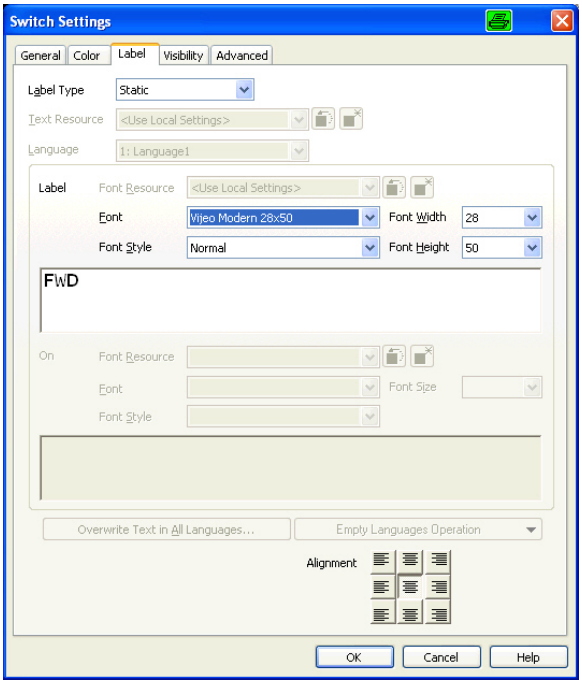
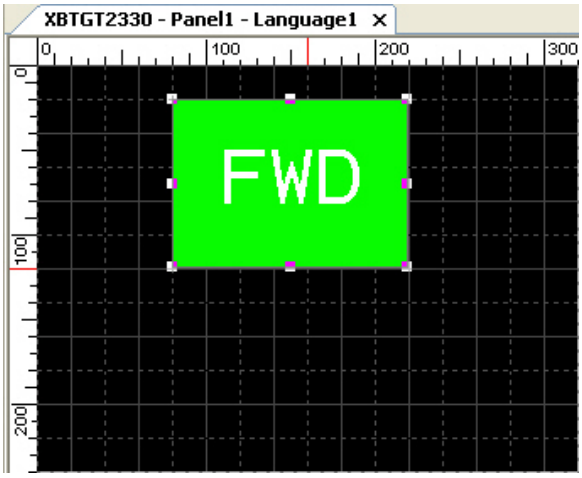
1	When these variables are added from the PLC application, Vijeo Designer creates a new equipment entry called **SOM_MyPLC** under **SoMachineNetwork01** for the communication with the PLC. Double click on **SOM_MyPLC**.	

2	Enter the PLC node name in the **Equipment Address** field. Then click on **OK**. Note: The node name of the PLC is displayed in the **Communication Settings** tab in **MyPLC** of SoMachine. In this project it is: **(M238) SN 274**.	 

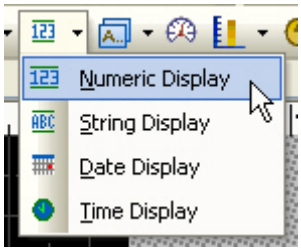
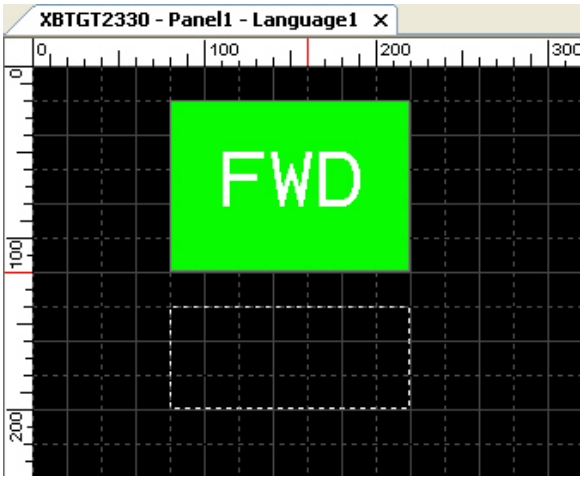
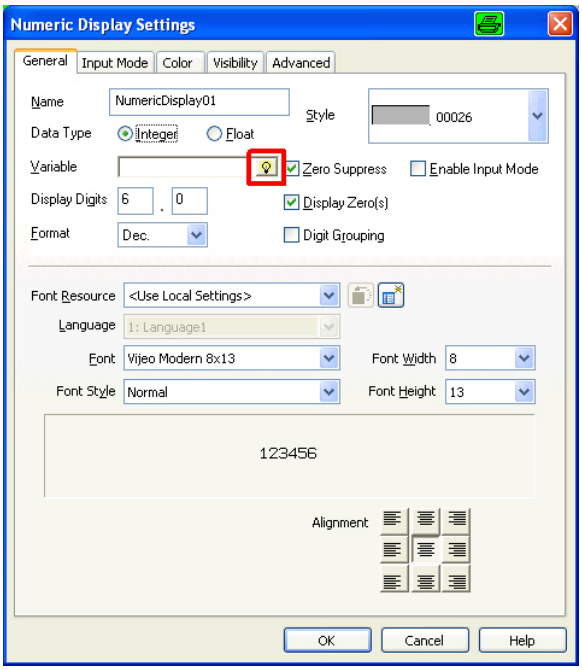
Create a Switch

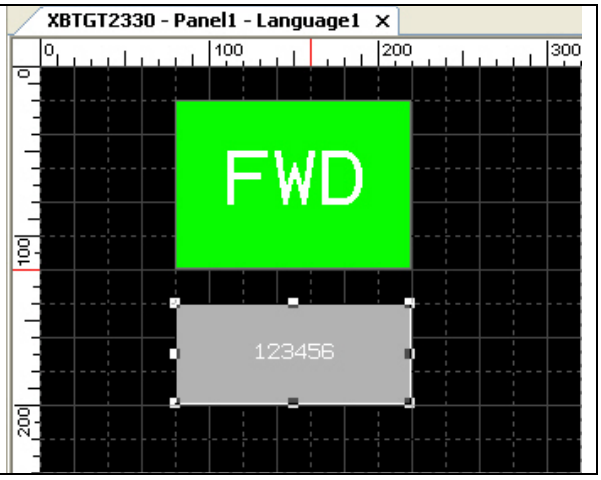
1	Click on the **Switch** icon in the toolbar.	
2	Click on the panel where you wish to position the switch and then drag the object to its required size. Then press Enter.	

3	In the **Switch Settings** dialog, under the tab **General**, click on the bulb icon at the end of the **Destination** field to select the variable that should be linked to the switch.	
4	In the **Variables List** dialog that opens, select the appropriate variable and click on **OK**.	
5	After the variable has been selected as the switch's **Destination**, click on **Add >**.	

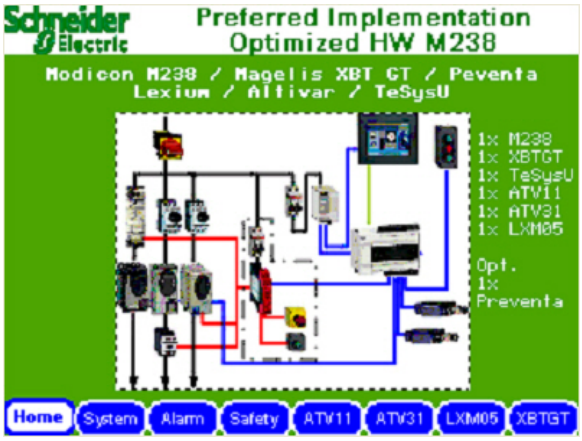
6	In the tab **Label**, select **Static** as the **Label Type** and enter a text that should appear on the switch, e.g. FWD. If you wish, you can modify the label's **Font** attributes (Style, Width, Height and Alignment). When you are satisfied with the switch settings, click on **OK**.	
7	The new switch can now be seen on the work frame.	

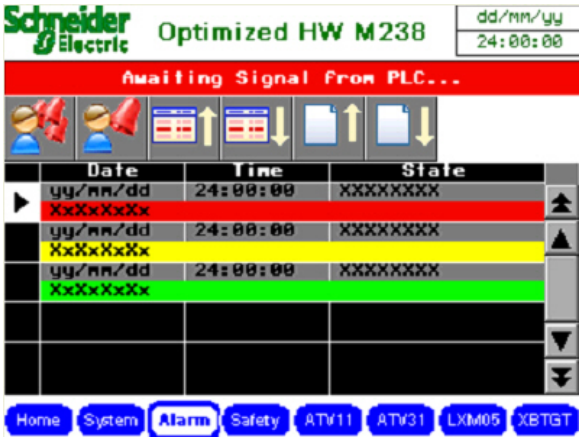
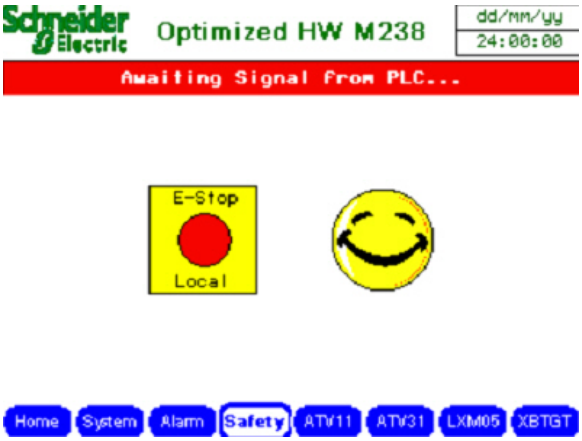
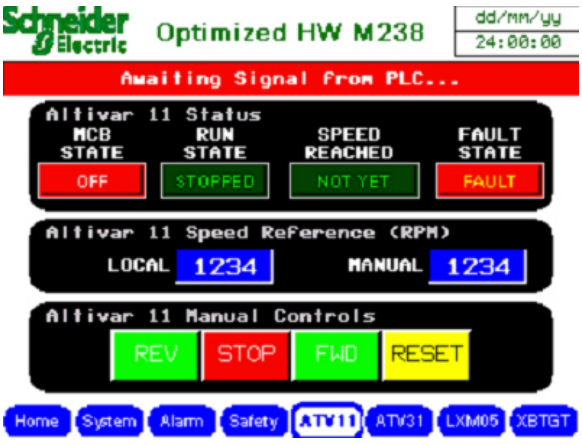
Create a Numeric Display

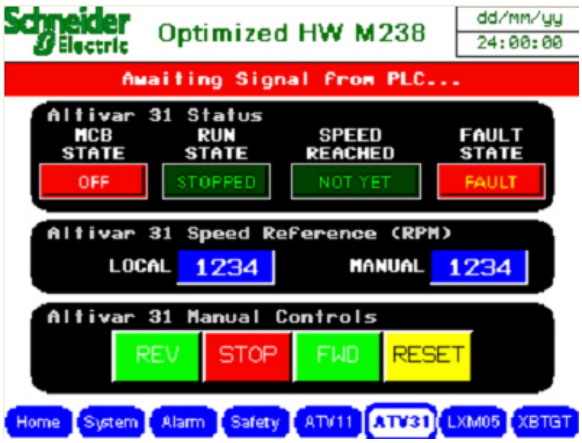
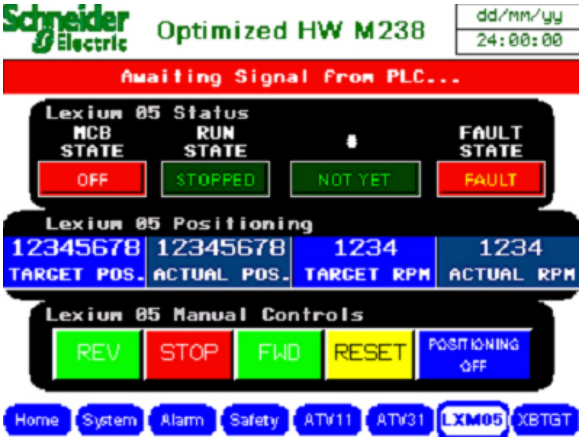
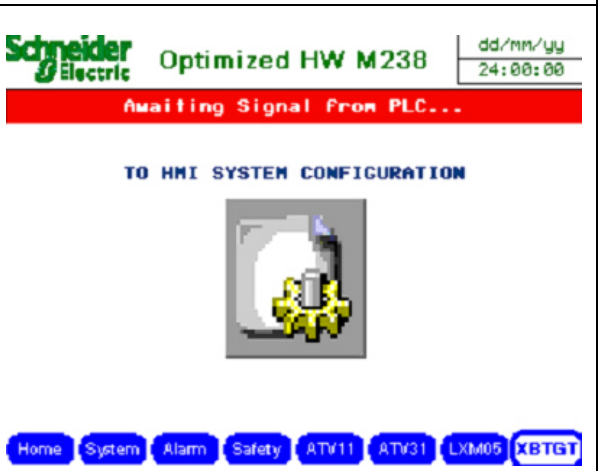
1	Click on the **Numeric Display** icon in the toolbar.	
2	Click on the panel where you wish to position the numeric display and then drag the object to its required size. Then press enter.	
3	In the **Numeric Display Settings** dialog, on the tab **General**, click on the bulb icon at the end of the **Variable** field to choose the variable that should be linked to the display. In **Display Digits**, you can set the maximum number of digits to be displayed for the integral and fractional part of the value.	

4	The created numeric display is now visible on the work frame.	

Example Screens

1	The main page of the HMI is called **Home** and displays a picture of the complete architecture.	
2	The **System** page has two functions: 1. To display the overall status for all devices 2. To select between LOCAL or MANUAL operation mode	

3	The **Alarm** page displays the status of the system alarms and logs them chronologically.	
4	Page **Safety** displays the status of the emergency stop relay.	
5	Page **ATV11** is for setting the speed references of the ATV11 drive and controlling the drive when the system is operating in Manual mode. It also displays the status of the drive.	

6	Page **ATV31** is for setting the speed references of the ATV31 drive and controlling the drive when the system is operating in Manual mode. It also displays the status of the drive.	
7	Page **LXM05** is used for setting the speed references of the LXM05 drive and controlling the drive in either speed or position mode when the system is operating in Manual mode. It also displays the status of the drive.	
8	Page **XBTGT** allows you to access to the HMI system configuration.	

Devices

Introduction

This chapter describes the steps required to initialise and configure the different devices required to attain the described system function.

General

The Altivar and Lexium drives can be configured using the operator's control panel on the device itself or by using the PowerSuite configuration software. Using the PowerSuite software tool has its advantages:

- Saving the configuration onto a hard drive and duplicating it
- Printing out the configuration for documentation and filing purposes
- Testing and optimising the parameters online (except for ATV11)

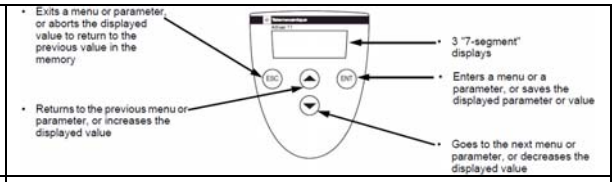
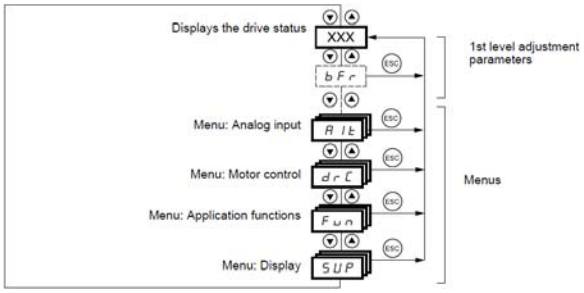
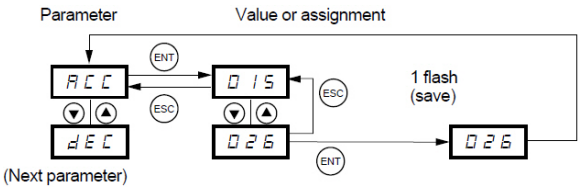
Before starting the PowerSuite software tool to configure the drives, the CoDeSys Gateway SysTray, running under Windows, must be stopped. The following section describes how to stop this gateway.

Stop the CoDeSys Gateway

1	Right click on the **CoDeSys Gateway SysTray** icon (red box) in the task list and select **Stop Gateway** in the pop-up menu.	
2	The colour of the **CoDeSys Gateway SysTray** icon changes from red to black to indicate that it has been stopped.	

ATV11 Control Panel

The ATV11 parameters can be entered or modified using the control panel on the front of the device. This section describes how to set up the drive using this control panel.

1	The drive parameters are set manually using the control buttons on the device.	
2	First, use the control buttons to navigate to the 1st level adjustment parameters to set the motor thermal current **ItH** to the motor nominal current as stated on the motor nameplate.	
3	In the **Analog input** menu **AIt**, set the **Scale of analog input AI1** parameter **ACt** to **10U** to configure the drive's speed reference as a 0-10V voltage.	
4	In the **Motor control** menu **drC**, set the motor nominal voltage, frequency, current, and cosine respectively in the parameters **UnS** (V), **FrS** (Hz), **nCr** (A), and **COS** according to the motor nameplate.	
5	In the **Application functions** menu **FUn**, disable the **Preset speeds** function **PS2** by setting both parameters **LIA** and **LIb** to **nO**.	
6	Also in the **Application functions** menu **FUn**, assign the **Fault reset** parameter **rSF** to **LI3** and the **Analog/logic output DO** function **dO** to **SrA** via its **Assignment** parameter **ACt**.	
7	Alternatively, these parameters can also be configured using the PowerSuite configuration software.	
8	**Note:** If the drive has an integrated reference potentiometer on the front of the drive (ATV11●●●●●●A and ATV11●●●●●●E327 models), configure the drive to operate in 2-wire control with analog input AI1 as its speed reference by setting the parameter **Act**, in the Type of control function **tCC** to **2C** and parameter **LSr** to **tEr** in the Application functions menu **Fun**.	

PowerSuite with ATV11

The parameters for the ATV11 can also be set using the PowerSuite configuration software. This section describes the PowerSuite procedure.

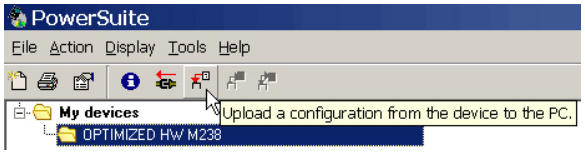
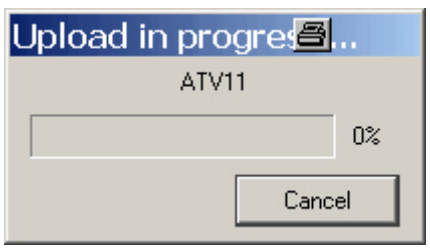
Before carrying out the steps described below, you must ensure that:

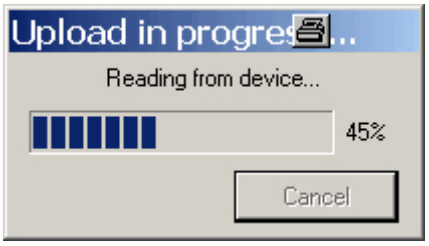
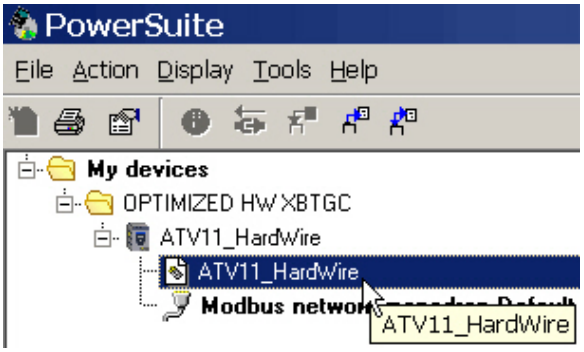
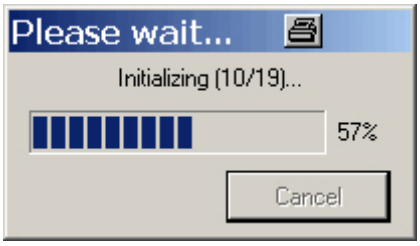
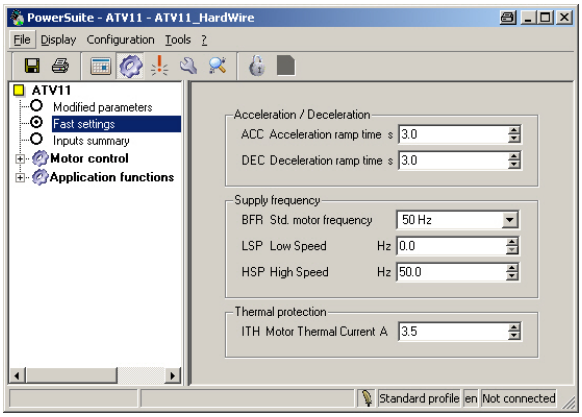
- The PowerSuite configuration software is installed on your PC.
- The variable speed drive is connected to the power supply.
- The PC is connected to the variable speed drive via the communication cable.
- The CoDeSys Gateway SysTray is stopped (refer to the *General* section at the beginning of this chapter).

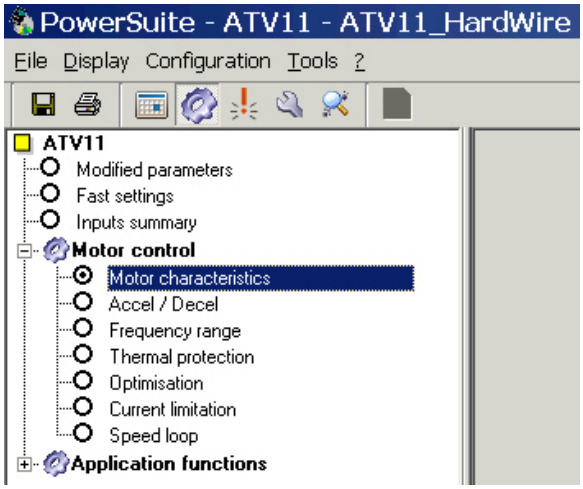
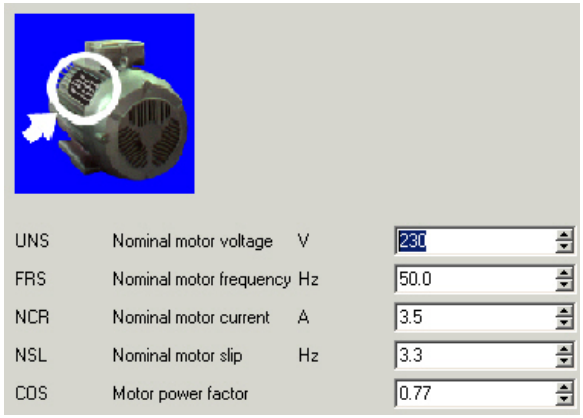
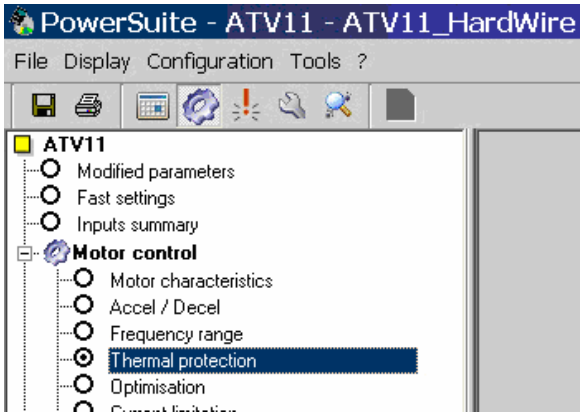
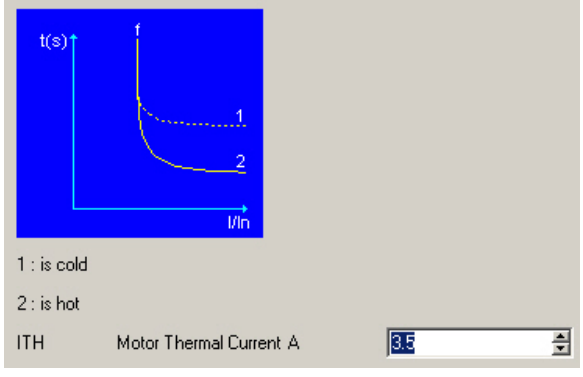
Auto-tuning ATV11

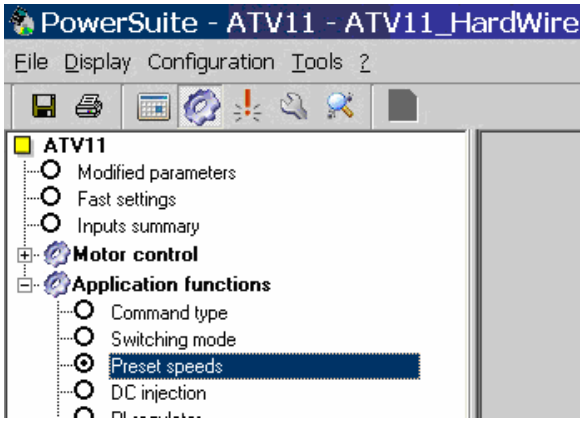
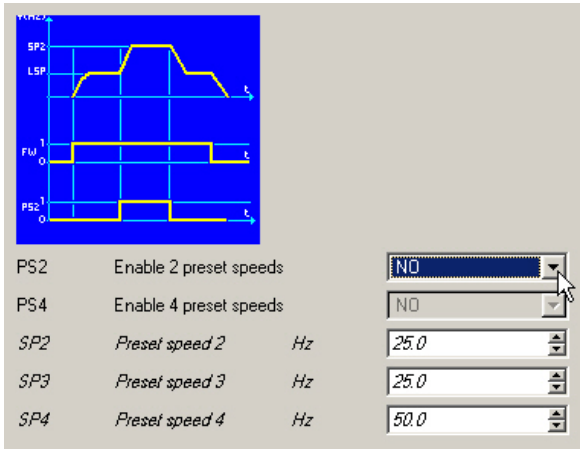
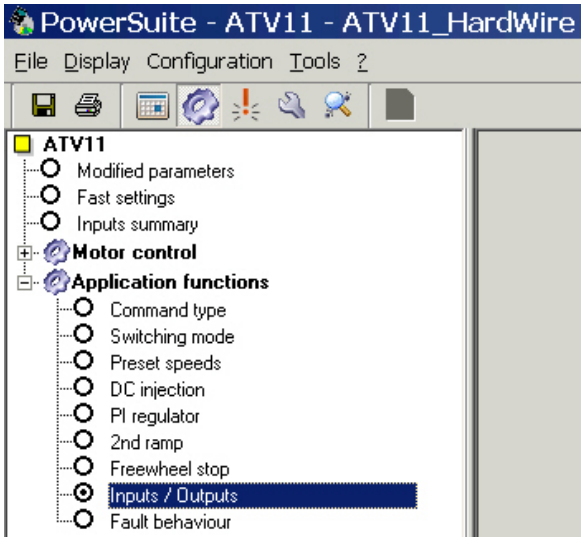
Auto-tuning is not required for the ATV11.

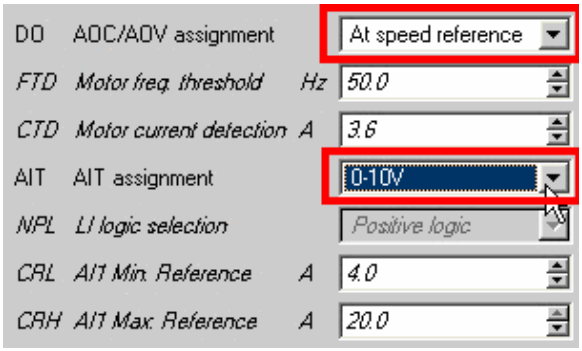
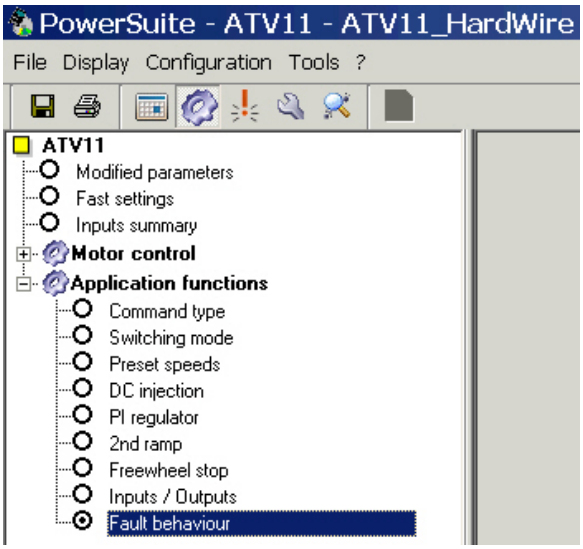
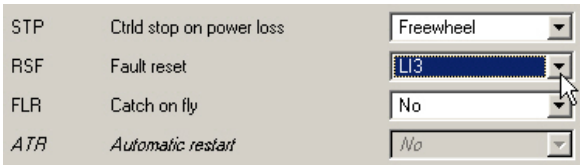
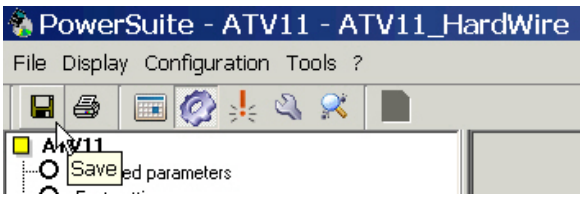
Upload Configuration

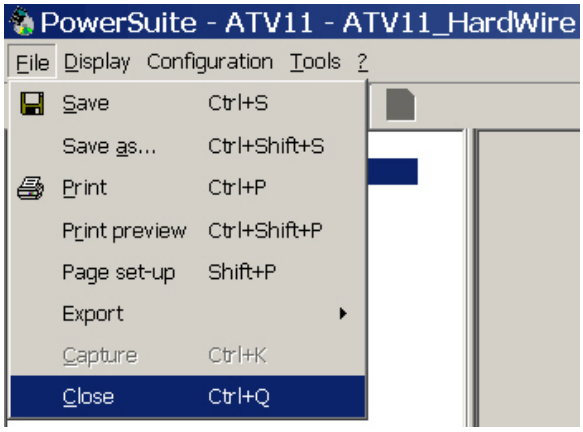
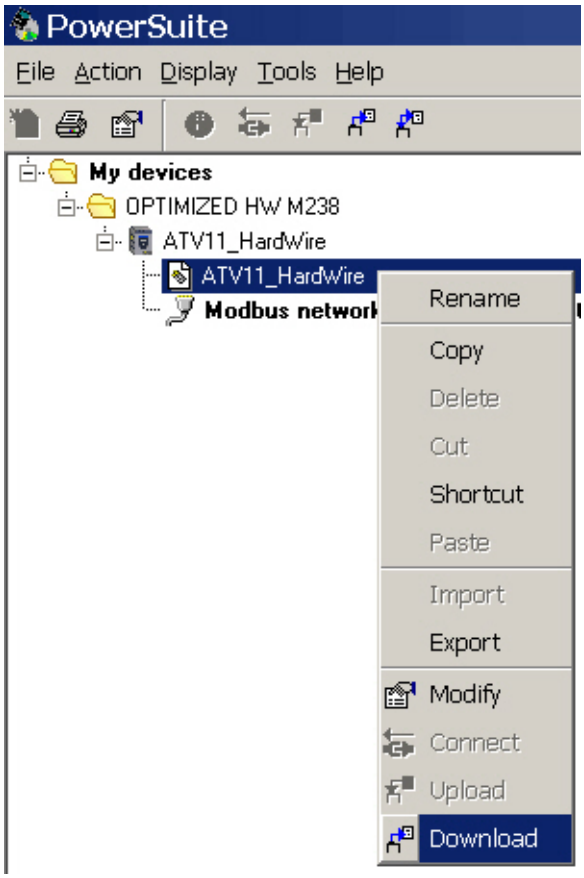
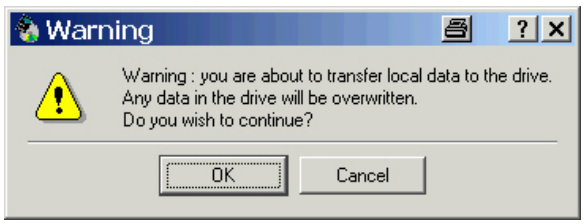
1	Use the **Upload** option in the **Action** menu or the equivalent icon in the toolbar to upload the configuration from the device. **Note:** Prior to this, you must have plugged in the connection cable from the PC to the ATV.	
2	Read the functional safety information and follow the instructions. Once you have checked it is safe to do so, you can press **ALT+F**.	
3	PowerSuite uploads the configuration from the ATV to the PC and displays a progress bar.	

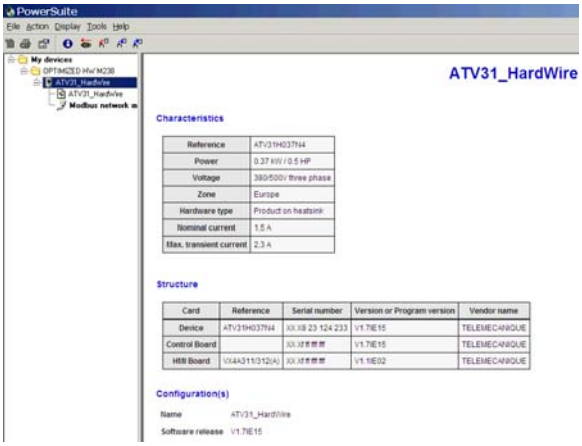
4	In the **New name** dialog, give the drive a name and click on **OK.**	
5	PowerSuite uploads the current drive data.	
6	To open the configuration dialog, double click on the configuration file that was created.	
7	PowerSuite prepares to open the configuration.	
8	The configuration dialog opens.	

9	Select: **Motor control →** **Motor characteristics**	
10	Enter the data indicated on the nameplate for the motor which is connected to the drive.	
11	Select: **Motor control →** **Thermal protection**	
12	Enter the nominal current of the motor indicated on the nameplate of the motor which is connected to the drive.	

13	Select: **Application functions →** **Preset speeds**	
14	Select **NO** in the **PS2** and **PS4** list box.	
15	Select: **Application functions →** **Inputs / Outputs**	

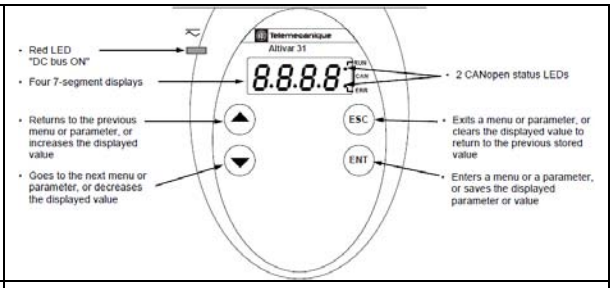
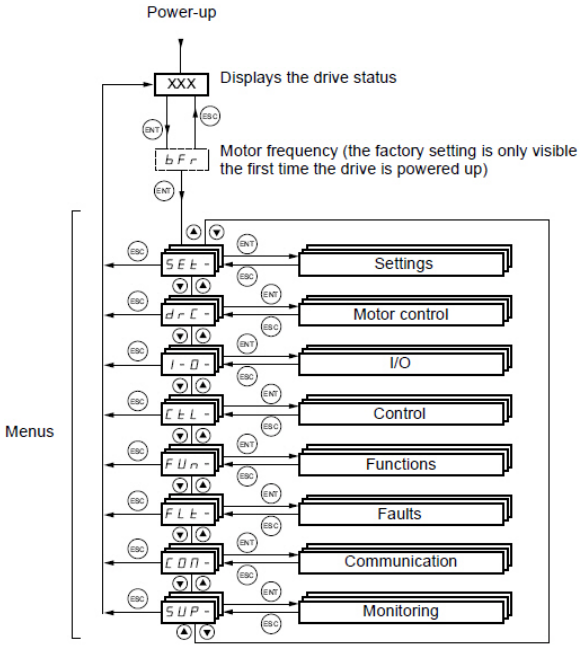
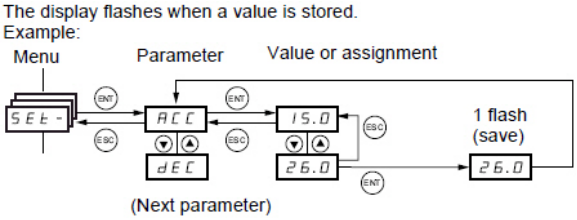
16	Select **At speed reference** in the **DO** list box and **0-10V** in the **AIT** list box.	
17	Select: **Application functions →** **Fault behaviour**	
18	Select **LI3** in the **RSF** list box.	
19	Save your settings by clicking on the disk icon in the toolbar.	

20	Use the **Close** option in the **File** menu or the system exit icon to close the configuration dialog.	
21	To download the data to the drive right click on the drive and select **Download.**	
22	You are notified that you will overwrite the actual data of the drive. Click **OK** to continue**.**	

23	In the main window you will see all the ATV data, e.g. the firmware version.	
24	**Note:** If the drive has an integrated reference potentiometer on the front of the drive (ATV11●●●●●●A and ATV11●●●●●●E327 models), configure the drive to operate in 2-wire control with analog input AI1 as its speed reference by going to **Application functions** → **Command type** inside the configuration dialog, and selecting **2-wire control** in the **TCC** list box and **Terminal reference** in the **LSR** list box.	

ATV31 Control Panel

The ATV31 parameters can be entered or modified via the control panel on the front of the device. This section describes how to set up the drive using this control panel.

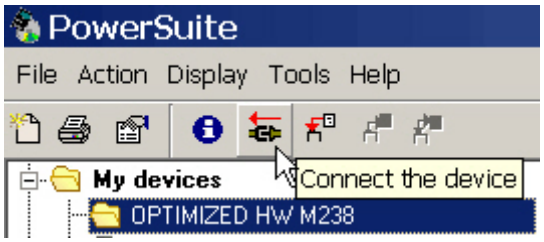
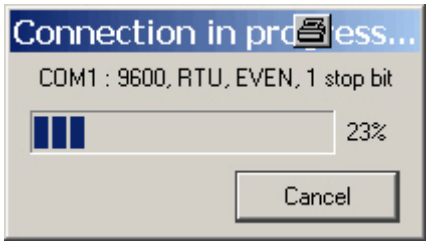
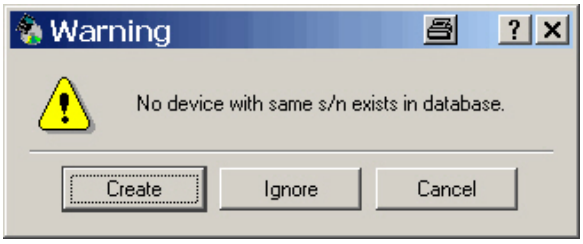
1	The drive parameters are set manually using the control buttons on the device.	
2	First, use the control buttons to navigate to the **Settings** menu **SEt-** to set the motor thermal protection **ItH** to the motor nominal current as stated on the motor nameplate.	
3	In the **Motor control** menu **drC-**, set the motor nominal voltage, frequency, current, speed and cos phi respectively in the parameters **UnS** (V), **FrS** (Hz), **nCr** (A), **nSP** (rpm) and **COS** according to the motor nameplate.	
4	In the **I/O** menu **I-O-**, assign the **Relay R2** parameter **r2** to **SrA**.	
5	In the **Application functions** menu **FUn-**, disable the **Preset speeds** function **PSS-** by setting both its parameters **PS2** and **PS4** to **nO**.	
6	In the **Fault** menu **FLt-**, assign the **Fault reset** parameter **rSF** to **LI3**.	The display flashes when a value is stored. Example: 
7	Alternatively, these parameters can also be configured using the PowerSuite configuration software.	
8	**Note:** If the drive has an integrated reference potentiometer on the front of the drive (ATV31●●●A model), configure the drive to operate in terminal block control by setting the parameter **tCC** in the I/O menu **I-O-** to **2C** and the parameter **Fr1** in the Control menu **CtL-** to **AI1**.	

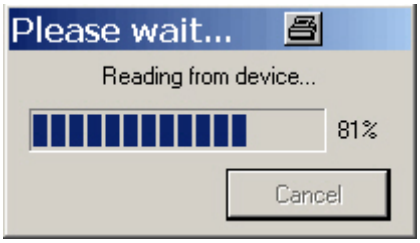
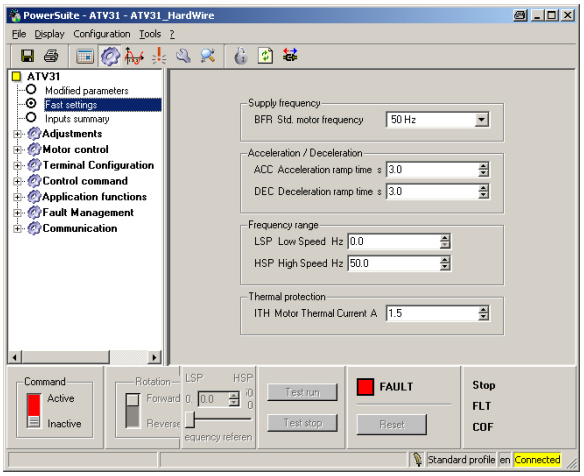
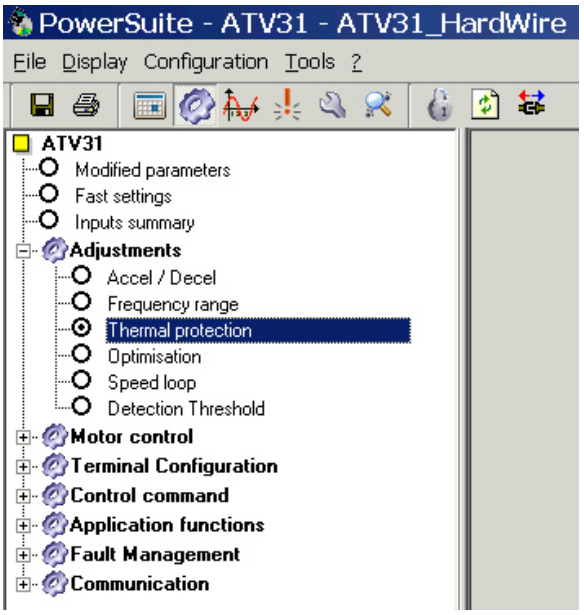
PowerSuite with ATV31

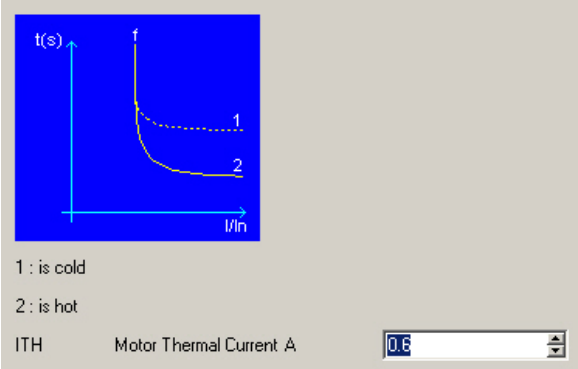
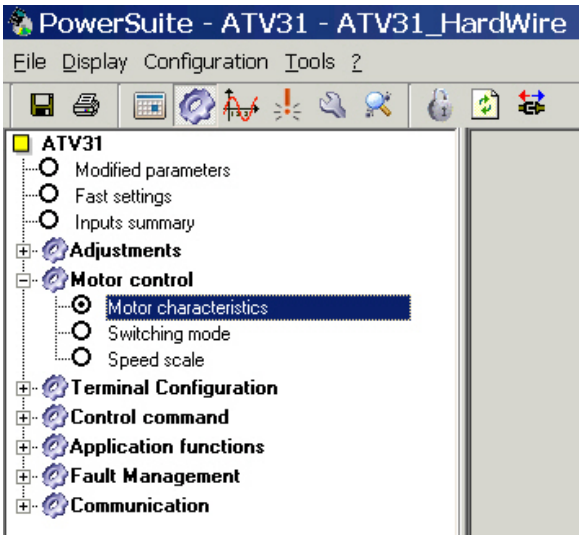
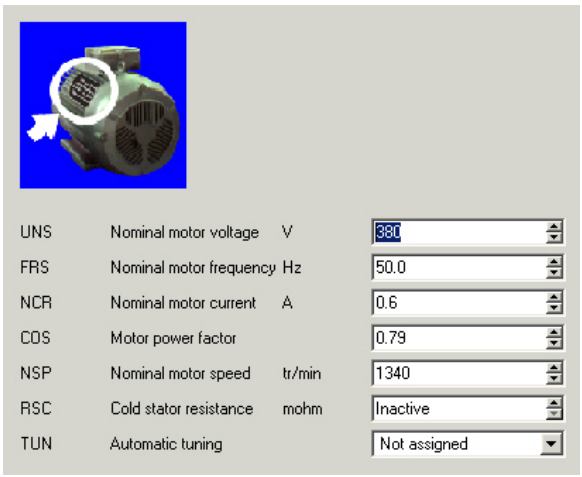
The parameters for the ATV31 can also be set using the PowerSuite configuration software. This section describes the PowerSuite procedure.

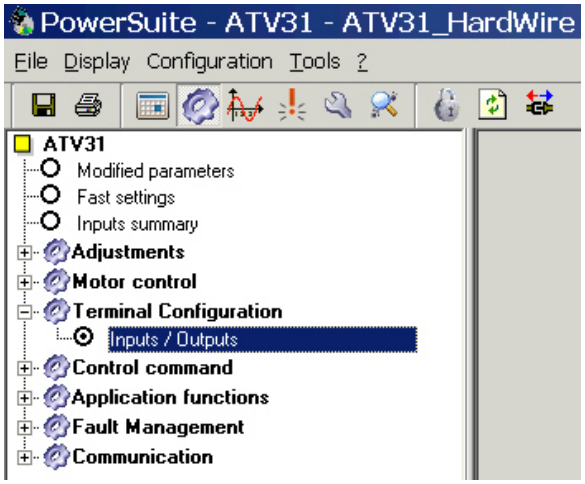
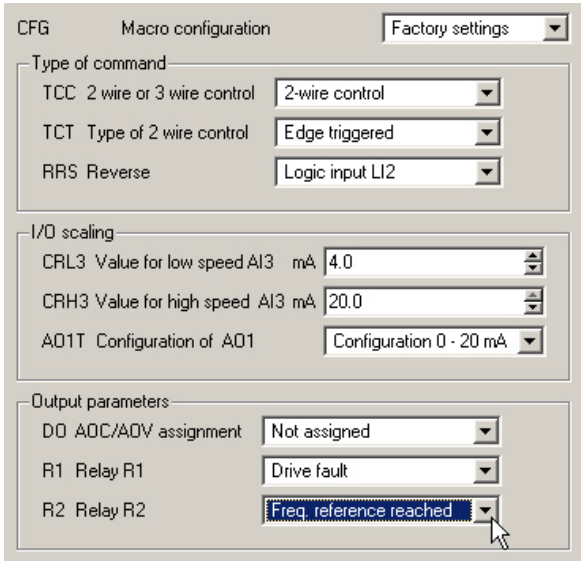
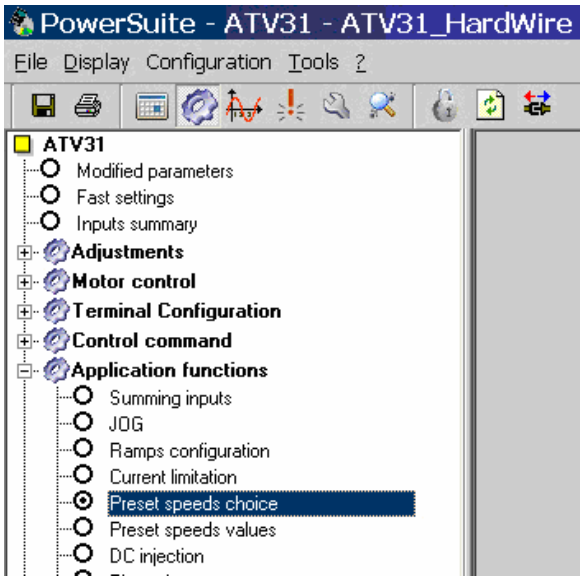
Before carrying out the steps described below, you must ensure that:

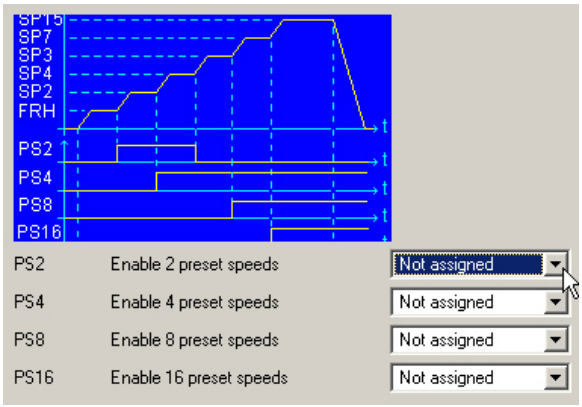
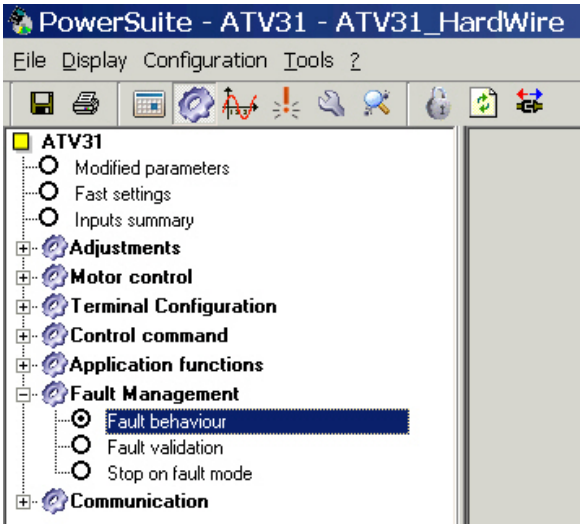
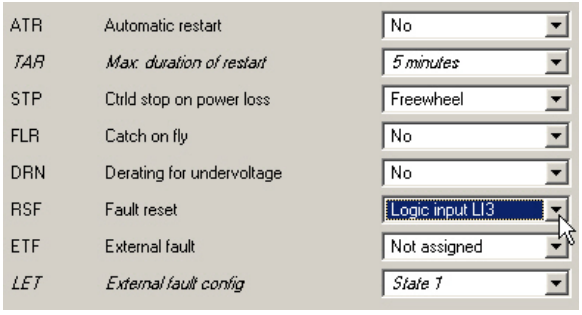
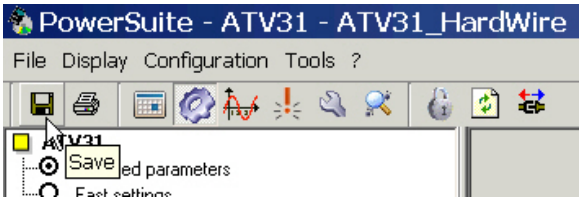
- The PowerSuite configuration software is installed on your PC.
- The variable speed drive is connected to the power supply.
- The PC is connected to the variable speed drive via the communication cable.
- The CoDeSys Gateway SysTray is stopped (refer to the General section at the beginning of this chapter).

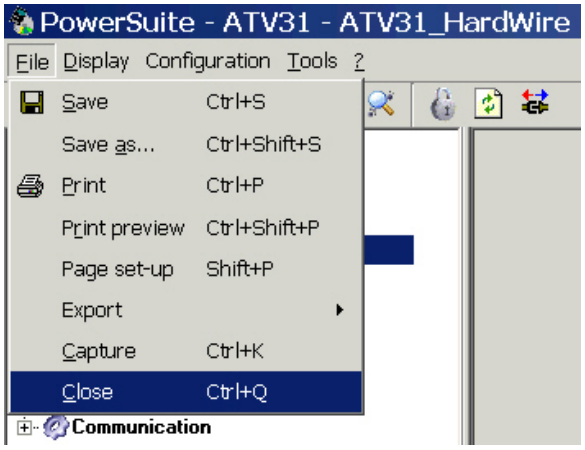
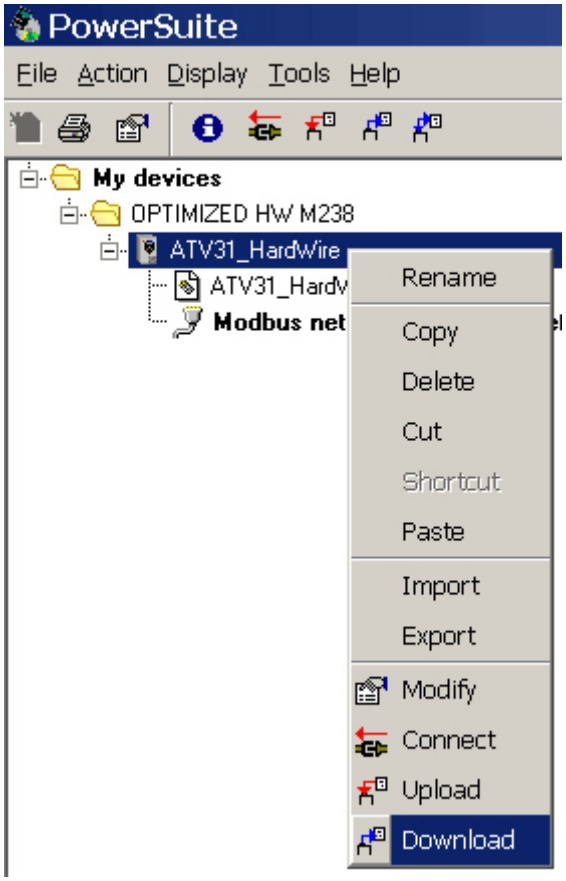
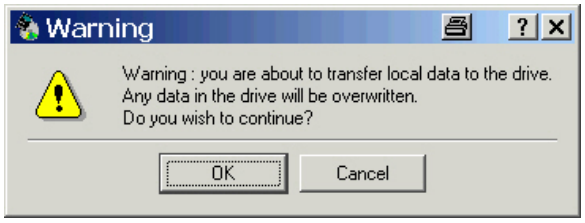
1	Use the **Connect** option in the **Action** menu or the equivalent icon in the tool bar to establish a connection with the device. **Note:** Prior to this, you must have plugged in the connection cable from the PC to the ATV.	
2	Read the functional safety information and follow the instructions. Once you have checked it is safe to do so, you can press **ALT+F**.	
3	PowerSuite attempts to connect to the ATV.	
4	PowerSuite recognises that it is a new device. Click on **Create.**	

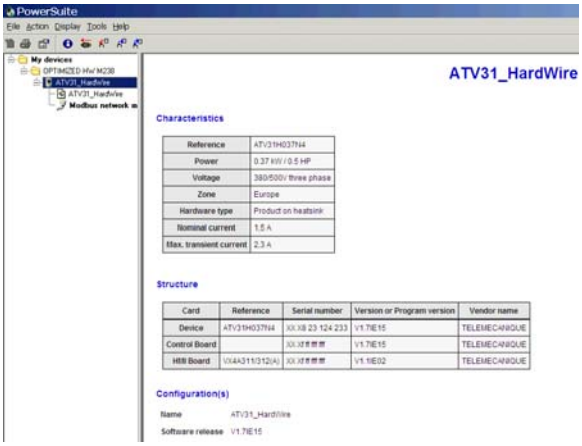
5	In the **New name** dialog, give the drive a name and click on **OK.**	
6	PowerSuite reads the actual drive data	
7	The configuration dialog opens.	
8	Go to **Adjustments →** **Thermal protection**	

9	Enter nominal current for the motor as shown on the nameplate of the motor which is connected to the drive.	
10	Select: **Motor control →** **Motor characteristics**	
11	Enter the data indicated on the nameplate for the motor which is connected to the drive.	

12	Select: **Terminal Configuration →** **Inputs / Outputs**	
13	Select **Freq. reference reached** in the **R2** list box.	
14	Select: **Application functions →** **Preset speeds choice**	

15	Select **Not assigned** in the **PS2** and **PS4** list box.	
16	Select: **Fault Management →** **Fault behaviour**	
17	Select **Logic input LI3** in the **RSF** list box.	
18	Save your settings by clicking on the disk icon in the toolbar.	

19	Use the **Close** option in the **File** menu or the system exit icon to close the configuration dialog.	
20	To download the data to the drive right click on the drive and select **Download.**	
21	You are notified that you will overwrite the actual data of the drive. Click **OK** to continue**.**	

22	In the Main window you will see all the ATV data, e.g. the firmware version.	
23	**Note:** If the drive has an integrated reference potentiometer on the front of the drive (ATV31●●●A model), configure the drive to operate in terminal block control by selecting **2-wire control** in the **TCC** list box in **Terminal Configuration → Inputs / Outputs**, and **Analog input AI1** in the **FR1** list box in **Control command → Control command** inside the configuration dialog.	

Auto-tuning ATV31

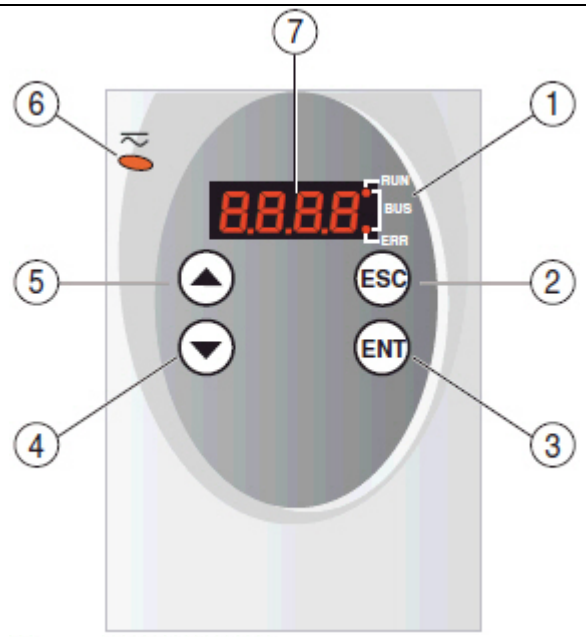
It is essential that all the motor parameters (UnS, FrS, nCr, nSP, COS) are configured correctly before performing auto-tuning.		
1	Auto-tuning is only performed if no command has been activated. Press **ENT**.	
2	Press the downwards arrow ▼ once and you see **drC-**. Press **ENT**.	

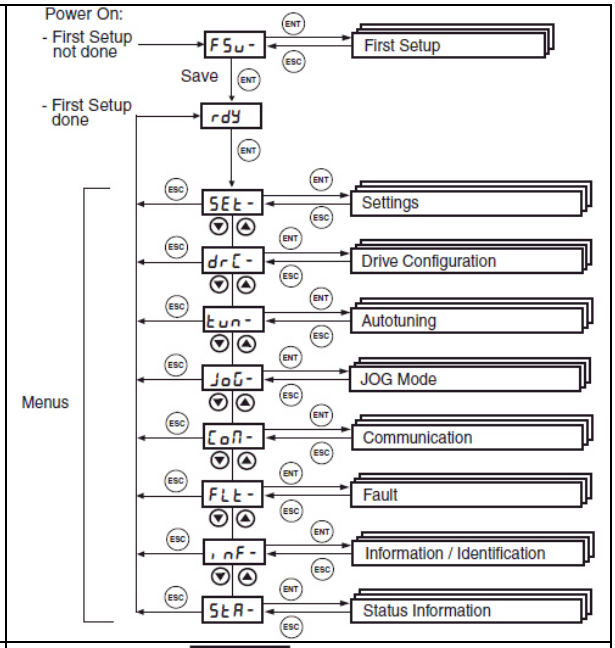
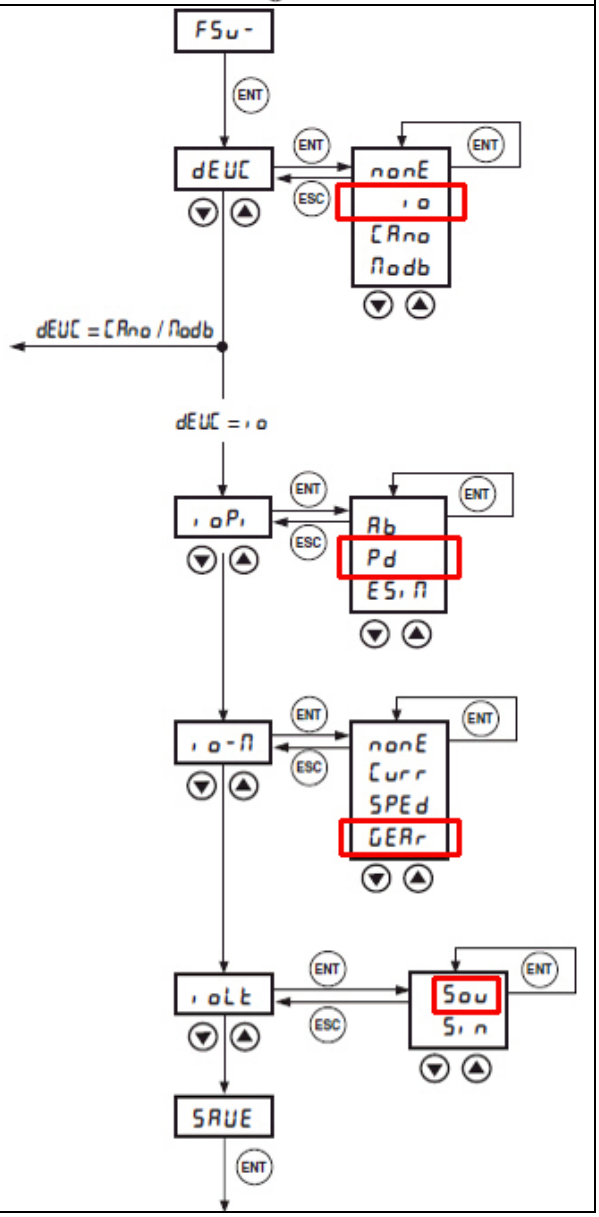
3	Press the downwards arrow ▼ seven times and you see **tUn**. Then press **ENT**.	
4	**nO** here indicates that auto-tuning has not been preformed and that the default stator resistance value is used to control the motor.	
5	Press the downwards arrow ▼ once and you see **yES**. Press **ENT**. Auto-tuning may take 1 to 2 seconds. Do not interrupt the tuning; wait for the display to change to "**dOnE**" or "**nO**". Note: During auto-tuning, the motor operates at nominal current.	

6	When the display changes to **dOnE**, the stator resistance measured by the auto-tuning function is used to control the motor.	
7	Press **ESC** three times to return to the drive status display.	

LXM05 Control Panel

The LXM05 parameters can be entered or modified via the control panel on the front of the device. This section describes how to set up the drive using this control panel.

1	Once the drive has been wired up, the drive has to be configured. The Lexium 05 offers the possibility to do this via the integrated HMI. You do not need a PC connection for the following three steps.	 (1) LEDs for fieldbus (2) ESC: - exit a menu or parameter - return from the displayed to the last saved value (3) ENT: - call a menu or parameter - save the displayed value to EEPROM (4) Down arrow: - switch to next menu or parameter - reduce the displayed value (5) Up arrow: - switch to previous menu or parameter - increase the displayed value (6) Red LED on: DC bus under power (7) Status display

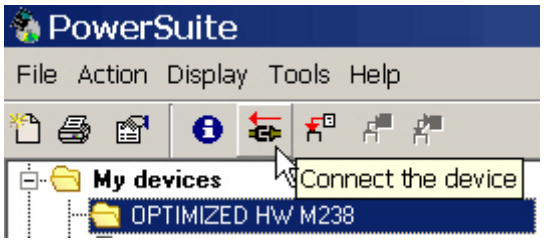
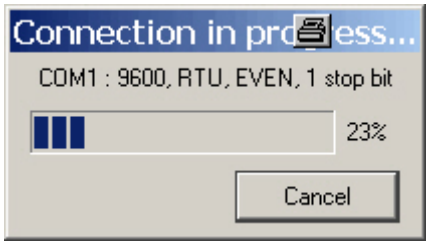
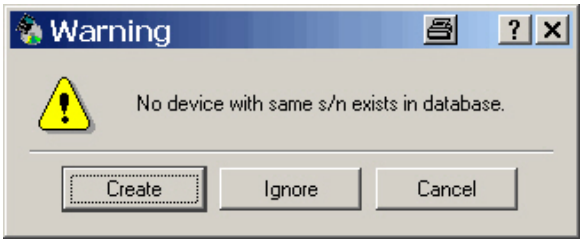
2	The HMI has a menu system. The picture shows the menu structure. For the connection via PowerSuite the Modbus parameters have to be checked. **CoM** is **MbAd = 1** and **Mbbd = 19.2**	
3	If the drive was started for the first time, or after a reset to the factory settings, all functions are blocked. **You have to go through the „First-Setup".** To configure the drive to operate in PULSE/DIR device control, the following have to be specified: - **Device Control Type (io)** - **Type of Position Interface (Pd)** - **Operating Mode for ‚local control mode' (GEAr)** - **Logic Type (Sou)** Once complete, save the configuration and power up the drive. The HMI will display **rdy**.	

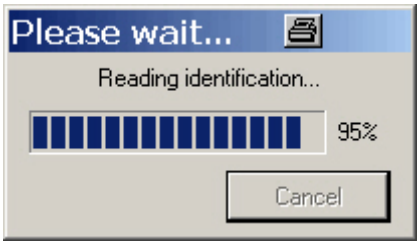
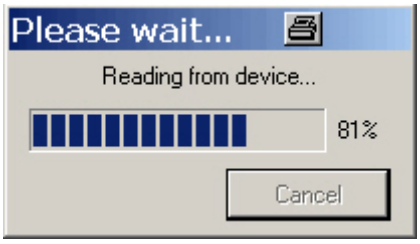
PowerSuite with LXM05

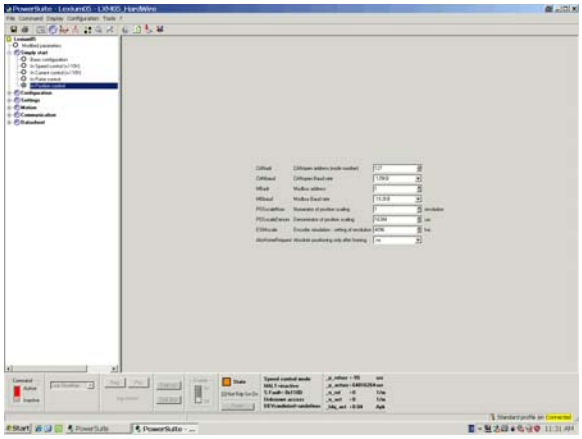
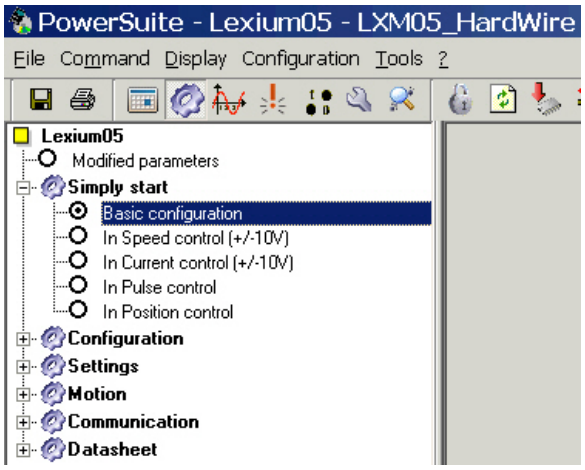
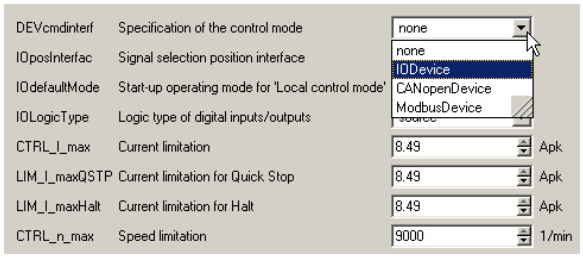
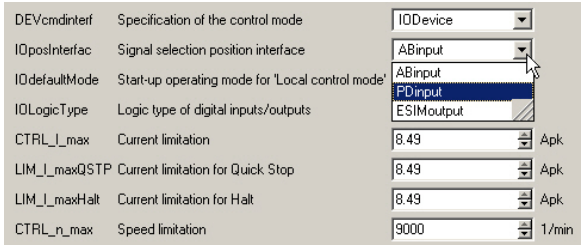
The parameters for the Lexium 05 can also be set using the PowerSuite configuration software. This section describes the PowerSuite procedure.

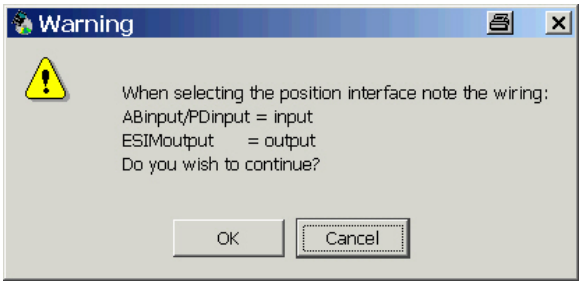
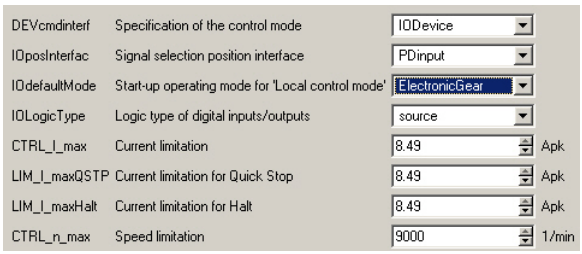
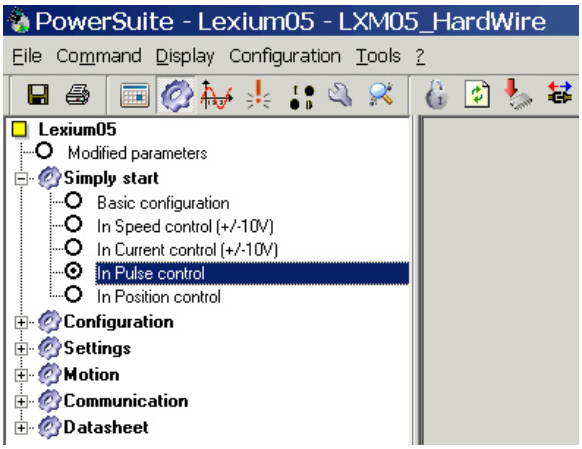
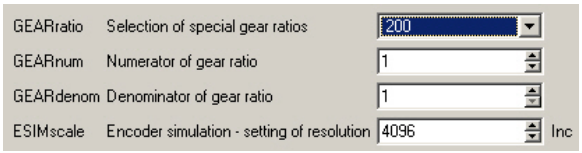
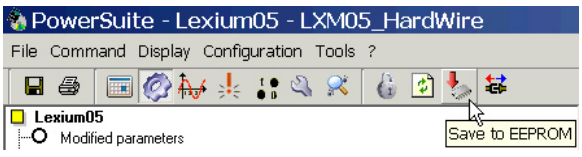
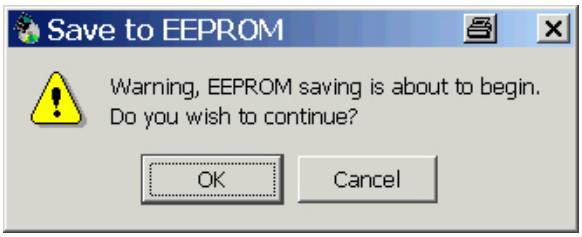
Before carrying out the steps described below, you must ensure that:

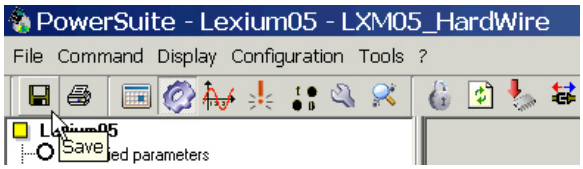
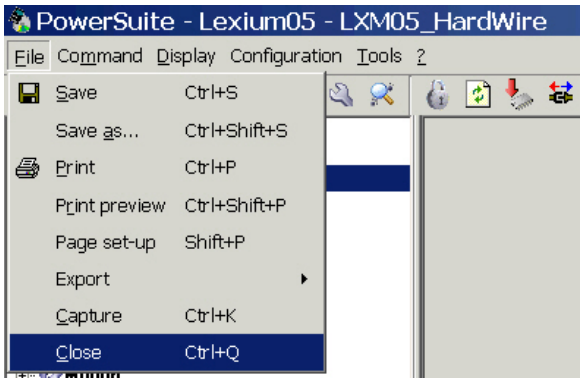
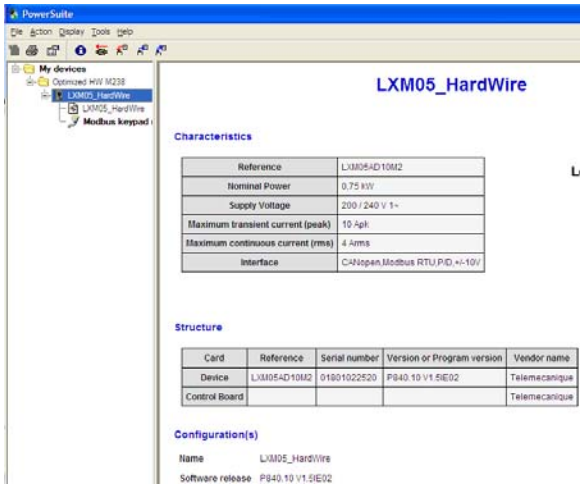
- The PowerSuite configuration software is installed on your PC.
- The variable speed drive is connected to the power supply.
- The PC is connected to the variable speed drive via the communication cable.
- The CoDeSys Gateway SysTray is stopped (refer to the *General* section at the beginning of this chapter).

1	Use the **Connect** option in the **Action** menu or the equivalent icon in the tool bar to establish a connection with the device. **Note:** Prior to this, you must have plugged in the connection cable from the PC to the LXM05.	
2	Read the functional safety information and follow the instructions. Once you have checked it is safe to do so, you can press **ALT+F**.	
3	PowerSuite tries to connect to the LXM05.	
4	PowerSuite recognises that it is a new device. Click on **Create.**	

5	In the **New name** dialog, give the drive a name and click on **OK.**	
6	PowerSuite reads the LXM05 identification that it is connected to.	
7	PowerSuite recognises that the drive is still in 'First Setup' state. Click on **OK** to continue.	
8	You are reminded that the drive must be re-restarted after it has been configured. Click **OK** to continue**.**	
9	PowerSuite reads the actual drive data	

10	The configuration dialog opens.	
11	Select: **Simply start →** **Basic configuration**	
12	Select **IODevice** in the **DEVcmdinterf** list box.	
13	You are notified that the newly configured device control is valid only after the configuration has been saved in the EEPROM and the drive has been re-powered. Click **OK** to continue**.**	
14	Select **PDinput** in the **IOposInterfac** list box.	

15	You are notified about the wiring differences between the three position interfaces. Click **OK** to continue**.**	
16	Select **ElectronicGear** in the **IOdefaultMode** list box.	
17	Select: **Simply start →** **In Pulse control**	
18	Select **200** in the **GEARratio** list box.	
19	Use the **Save to EEPROM** option in the **Configuration** menu or the equivalent icon in the tool bar to save the current configuration in the EEPROM of the drive.	
20	You are notified that saving to EEPROM is about to begin. Click **OK** to continue**.**	

21	You will receive a confirmation that saving to EEPROM was successful. Click **OK** to continue**.**	
22	Save your settings by clicking on the disk icon in the toolbar.	
23	Use the **Close** option in the **File** menu or the system exit icon to close the configuration dialog.	
24	In the Main window you will see all the LXM05 data, e.g. the firmware version.	
25	**Note:** The LXM05 only works with the new device control (i.e. **IODevice**) once a power cycle (on/off/on) has been carried out.	

Auto-tuning LXM05

Auto-tuning determines the friction torque (an ever present load torque) and takes it into account in the calculation of the moment of inertia of the total system. External factors, such as a load on the motor, are taken into account.

Note:
The HALT input of the LXM05 (Pin 36 of CN1) must be connected, and has to be supplied with +24VDC to enable the LXM05 to perform auto-tuning. Otherwise, auto-tuning will not succeed.

1	Auto-tuning is only performed if no command has been activated. Press **ENT**.	
2	Press the downwards arrow ▼ three times and you see **tun-**. Press **ENT**.	
3	When **Strt** is displayed, press **ENT** to start the auto-tuning.	

4	Auto-tuning may take1 to 2 minutes. Do not interrupt; wait for the display to change to "**donE**". If the Auto-tuning is interrupted the default values are imported.	
5	When the display changes to **donE**, the calculated values are accepted immediately without an additional save.	
6	Press **ESC** three times to return to the drive status display.	

Appendix

Detailed Component List

Sarel Cabinet

Hardware-Components				
Pos.	**Amt.**	**Description**	**Part Number**	**Rev./ Vers.**
1.1	1	Cabinet light	ENNLA6000	
1.2	1	Cabinet light cable	ENNLA6001	
1.3	1	Wiring diagram pocket	ENN21322	
1.4	1	Thermostat 1NC 0-60 °C	ENN17562	
1.5	1	Fan with filter 230V, 46W	ENN17903	
1.6	1	Air filter for cabinet, 250x250	ENN17912	
1.7	1	Switch cabinet and mounting plate	ENN83359	

Mains Switch

Hardware-Components				
Pos.	**Amt.**	**Description**	**Part Number**	**Rev./ Vers.**
2.1	1	Mains switch 25A 3pin flush mounting	VCD0	
2.2	1	Auxiliary contact block	VZ7	
2.3	1	Power supply plug, 3P+N+PE	6008648	

Power Supply

Hardware-Components				
Pos.	**Amt.**	**Description**	**Part Number**	**Rev./ Vers.**
3.1	1	Power supply 230V/24VDC, 5A, 120W	ABL8REM24050	
3.2	3	Circuit breaker C60 1P 2A C	23726	
3.3	1	Circuit breaker C60N 2P C	23747	
3.4	1	Circuit breaker C60H 3A D	24518	
3.5	2	Circuit breaker C60L 1P 2A Z	26135	
3.6	1	Circuit breaker C60N 2P 10A C	23756	
3.7	1	Earth disconnect terminal	5711016550	

HMI

Hardware-Components				
Pos.	**Amt.**	**Description**	**Part Number**	**Rev./ Vers.**
4.1	1	Magelis XBTGT 5.7“ touch display	XBTGT2330	V1.1

Automation Components

Hardware-Components				
Pos.	**Amt.**	**Description**	**Part Number**	**Rev./ Vers.**
5.1	1	Modicon M238 PLC, 14 Digital Inputs, 10 Digital Outputs	TM238LFDC24DT	
5.2	1	Digital input extension module, 16 Sink/Source inputs, 24VDC	TM2DDI16DT	
5.3	1	Digital output extension module, 8 Source outputs, 24VDC	TM2DDO8TT	
5.4	1	Analogue extension module 2 IN/1 OUT, 0-10V/4-20mA	TM2AMM3HT	
5.5	1	Analogue extension module 2 IN Pt 100 and Thermocouple K,J,T /1 OUT 0-10V/4-20mA	TM2ALM3LT	

Drives and Power

Hardware-Components				
Pos.	**Amt.**	**Description**	**Part Number**	**Rev./ Vers.**
6.1	1	ATV 11 variable frequency drive 0.75 kW, 200/240V	ATV11PU18M2E	V1.2 IE21
6.2	1	ATV 31 variable frequency drive 0.37 kW, 380/500V	ATV31H037N4	V1.7 IE15
6.3	1	Lexium 05 servo drive 0.75 kW, 200/240V	LXM05AD10M2	V1.5 IE02
6.4	1	Servo motor without brake, 0.5Nm, 6000rpm, 0.54kW	BSH0552T02A2A	
6.5	1	TeSys U base unit for two directions	LU2B12BL	
6.6	1	TeSys U wiring kit	LU2MB0BL	
6.7	1	TeSys U standard control unit	LUCL12BL	
6.8	1	TeSys U auxiliary contact block	LUFN20	
6.9	1	Motor circuit breaker 2.5A for upstream ATV31	GV2L07	
6.10	1	Motor circuit breaker 10A for upstream LXM05	GV2L14	
6.11	2	Auxiliary contacts 1NO+1NC for circuit breaker	GVAE11	
6.12	1	Contactor for downstream ATV31, 4kW, 24VDC	LC1D09BD	
6.13	1	Power cable for Lexium 05, 3m	VW3M5101R30	
6.14	1	Encoder cable for Lexium 05, 3m	VW3M8101R30	
6.15	1	USIC adapter for Pulse/Dir interface to PLC	VW3M3102	
6.16	1	USIC-LXM05 Cable, 1.5m	VW3M8209R15	
6.17	1	USIC-PLC Cable, 1.5m	VW3M8210R15	
6.18	1	Coupling relay as an interface module between ATV11 and PLC, 24VDC	ABS2EC01EB	

Sensor

Hardware-Components				
Pos.	**Amt.**	**Description**	**Part Number**	**Rev./ Vers.**
7.1	2	OsiSwitch Limit Switch	XCKP2118P16	

Safety E-Stop

Hardware-Components				
Pos.	**Amt.**	**Description**	**Part Number**	**Rev./ Vers.**
8.1	1	E-Stop Mushroom push button, red-yellow (E-Stop)	XB5AS844	
8.2	1	Safety E-Stop relay module	XPSAC5121	
8.3	1	Auxiliary contacts for E-Stop	ZB5AZ141	
8.4	1	Circular legend for E-Stop mushroom head pushbutton, 90mm diameter	ZBY8330	

Display and Indicators

Hardware-Components				
Pos.	**Amt.**	**Description**	**Part Number**	**Rev./ Vers.**
9.1	1	Assembly housing for 1 Style 5 button	XALD01	
9.2	1	Assembly housing for 2 Style 5 buttons	XALD02	
9.3	1	Three position selector switch	XB5AD33	
9.4	1	Signal lamp white LED	XB5AVB1	
9.5	1	Illuminated pushbutton with red LED 1NC/1NO	XB5AW34B5	
9.6	2	Illuminated pushbutton with blue LED 1 NC	XB5AW36B5	

Software Tools

Software-Components				
Pos.	**Amt.**	**Description**	**Part Number**	**Rev./ Vers.**
10.1	1	SoMachine (includes Vijeo Designer)	MSDCHNSFUV10	V1.0
10.2	1	PowerSuite Parameterization Software	VW3A8104	V2.5
10.3	1	PC→XBTGT Programming cable, USB to USB	XBTZG935	
10.4	1	XBTGT→M238 PLC Download cable, SubD9 to RJ45	XBTZ9008	
10.5	1	PowerSuite PC↔Altivar/Lexium Connection kit	VW3A8106	

Component Protection Classes

Positioning	Component	In Field, On Site			Cabinet		
					Front		Inside
Protection Class		IP54	IP65	IP67	IP55	IP65	IP20
	Mains Switch, with or without undervoltage protection and integrated indicator						X
	Emergency Stop switch housing XALK		X				
	Preventa module XPSAC5121						X
	Single/Double switch housing, complete		X				
	Control switch, 3 positions					X	
	Indicator buttons, all colours		X				
	Buttons with LED + 1 switch(1S), all colours						X
	Labels 30x40, all texts		X				
	Positions switch Universal		X				
	Contactor, all types						X
	Phaseo Power Supply 24 V DC/5 A						X
	Modicon M238 PLC						X
	TM2 I/O Expansion Modules						X
	Magelis HMI Display XBTGT					X	X
	Lexium 05 Servo Drive						X
	BSH Servo Motor		X shaft end IP40				
	Altivar 31 Variable Speed Drive						X
	Altivar 11 Variable Speed Drive						X

Component Features

Components

Vario Switch Disconnector VCD 0

Vario rotary switch disconnectors from 12 to 175 A are suitable for on-load making and breaking of resistive or mixed resistive and inductive circuits where frequent operation is required. They can also be used for direct switching of motors in utilisation categories AC-3 and DC-3 specific to motors.

- 3-pole rotary switch disconnectors, 12 to 175 A
- Padlockable operating handle (padlocks not supplied)
- Degree of protection IP 65

Preventa Safety Module: XPSAC5121

Main technical characteristics:

For monitoring	Emergency stop
Max. category accord. EN954-1	3
No. of safety circuits	3 N/O
No. of additional circuits	1 Solid-State
Indicators	2 LED
Power supply AC/DC	24V
Response time on input opening	< 100 ms
AC-15 breaking capacity	C300
DC-13 breaking capacity	24V/2A - L/R 50ms
Minimum voltage and current	17V/10mA
Dimensions (mm)	114 x 22,5 x 99
Connection	Captive screw-clamp terminals
Degree of protection	IP20 (terminals) IP40 (casing)

Safety modules XPS AC are used for monitoring Emergency stop circuits conforming to standards EN/ISO 13850 and EN 60204-1 and also meet the functional safety requirements for the electrical monitoring of switches in protection devices conforming to standard EN 1088/ISO 14119. They provide protection for both the machine operator and the machine by immediately stopping the dangerous movement on receipt of a stop instruction from the operator, or on detection of a fault in the safety circuit itself.

Power Supply Phaseo: ABL8RPS24100

- Single or two phase connection
- 100...120V and 200...500V input
- 24VDC output
- 10A output
- Diagnostic relay
- Protected against overload and short circuits

Magelis Display Terminal: XBT-GT2330

- Sensor screen (STN-Technology) with 24V DC power supply
- Brightness and Contrast adjustment
- Communication via Uni-Telway and Modbus. Communication via Ethernet TCP/IP is also available in specific models
- Flat Profile
- Memory expansion for application program
- Temperature range: 0..+ 50°C
- Certificates: UL, CSA

Modicon PLC: M238

The M238 is powered with 24 VDC, offer:

- 14 x 24 Vdc inputs including 8 fast inputs, dedicated to special functions such as HSC high-speed counting
- 10 x 24 Vdc solid state outputs including 4 fast outputs, dedicated to special functions such as counting, PWM and PTO
- An RS 232/RS 485 serial link (ASCII or Modbus protocol).
- A Modbus RS 485 serial link mainly dedicated to connection of a Human/Machine interface terminal (link providing a 5 V power supply for a Magelis Small Panel XBT NP00/R400/RT500)
- Extension of the number of I/O by the addition to the right of the base of 7 extension modules maximum that can be the following types:
    - Discrete TM2 DDI/DDO/DMM/DRA
    - Analog TM2 AMI/ALM/ARI/AMO/AVO/AMM
    - High-speed counter TM200 HSC210DT/DF

Altivar 11 Variable Speed Drive: ATV11PU18M2E

The Altivar 11 is a variable speed drive for 3-phase squirrel cage asynchronous motors rated between 0.18 kW and 2.2 kW.

There are three types of power supply:

- 100 V to 120 V single phase
- 200 V to 240 V single phase
- 200 V to 230 V 3-phase

The Altivar 11 incorporates specific features for local markets (Europe range, America range, Asia range) and has functions suitable for the most common applications, including:

- Horizontal materials handling (small conveyors, etc)
- Ventilation, pumping, access control, automatic doors
- Special machines (mixers, washing machines, centrifuges, etc)

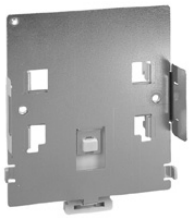
Altivar 11 drives are supplied with either a heat-sink for normal environments and ventilated enclosures, or on a base plate for mounting on a machine frame, when the size of the frame enables dissipation of the heat.

Altivar 31 Variable Speed Drive: ATV31H037N4

The Altivar 31 drive is a variable speed drive for 3-phase squirrel cage asynchronous motors. The Altivar 31 is robust, compact, easy to use and conforms to EN 50190, IEC/EN 61800-2, IEC/EN 61800-3 standards UL/CSA certification and to CE marking.

It incorporates functions that are suitable for the most common applications, including:

- Materials handling (small conveyors, hoists, etc)
- Packing and packaging machines
- Specialist machines (mixers, kneaders, textile machines, etc.)
- Pumps, compressors, fans



Altivar 31 drives communicate on Modbus and CANopen industrial buses. These two protocols are integrated as standard into the drive.

Altivar 31 drives are supplied with a heatsink for normal environments and ventilated enclosures. Multiple units can be mounted side by side to save space.

Drives are available for motor ratings between 0.18 kW and 15 kW, with four types of power supply:

- 200 V to 240 V single phase, 0.18 kW to 2.2 kW
- 200 V to 240 V 3-phase, 0.18 kW to 15 kW
- 380 V to 500 V 3-phase, 0.37 kW to 15 kW
- 525 V to 600 V 3-phase, 0.75 kW to 15 kW

Lexium 05 Servo Drive: LXM05AD10M2

- Voltage range:
  Single-phase 100 – 120 V AC or 200 – 240 V AC
  Three-phase 200 – 240 V AC or 380 – 480 V AC
- Power: 0.4 to 6 kW
- Rated torque: 0.5 to 36 Nm
- Rated speed: 1500 to 8000 rpm
- The compact design allows for space-saving installation of the drive in control cabinets or machines.
- Features the "Power Removal" (Safe Stop) functional safety function, which prevents the motor from being started accidentally. Category 3 with machine standard EN 954-1
- Lexium 05 servo amplifiers are fitted with a brake resistor as standard (an external brake resistor is optional)
- Quick control loop scan time: 62.5 µs for current control loop, 250 µs for speed control loop and 250 µs for position control loop
- Operating modes: Point-to-point positioning (relative and absolute), electronic gears, speed profile, speed control and manual operation for straightforward setup.
- Control interfaces:
  CANopen, Modbus or Profibus DP
  Analog reference inputs with ± 10 V
  Logic inputs and outputs
- The PowerSuite dialog tool enables the Lexium 05 servo drive to be configured, set and tested.

TeSys Model U: LU2B12BL

One power base
Control unit 0.15 to 32 A

- Only 6 setting ranges up to 32 A
- Only 4 voltage ranges up to 240 V AC/DC
- 3 versions: Standard, Extended, Multifunctional

Overall width 45 mm
Complete reversing contactor combination 0.15 to 32 A
Auxiliary switches and function modules

- Integrated: Motor circuit breaker auxiliary contact 1 NC, with connectors
- Integrated: Contactor auxiliary contacts 1 NO + 1 NC, freely available
- Option: Auxiliary switch module with 2 contactor state contacts
- Option: “Error” and “Selector switch position” signal contact
- Alarm – thermal overload function module
- Motor load display function module (0 to 10 V, 4 to 20 mA)
- Differentiated error display function module (under development)

Communication modules

- Parallel wiring; with plug-in connection cables up to eight motor controls can be supplied on one distribution module
- Modbus RTU protocol
- AS-Interface
- CANopen
- Gateway: FIPIO/Modbus, DeviceNet/Modbus, Profibus DP/Modbus

SoMachine OEM Machine Programming Software:
MSD CHNSFUV10

SoMachine is the OEM solution software for developing, configuring and commissioning the entire machine in a single software environment, including logic, motor control, HMI and related network automation functions.

- Features all IEC 61131-3 languages, integrated fieldbus configurators, expert diagnostics and debugging, as well as outstanding capabilities for maintenance and visualisation, including Java scripting
- Flexible Control platforms that include:
  - HMI Controller
    - XBTGC
  - Programmable logic controller
    - Modicon M238
  - HMI Magelis graphic panels
    - XBT GT
    - XBT GK
- HMI functionality through the integrated Vijeo Designer working environment, which is a user-friendly interface that includes advanced functions such as multimedia support
- One software package, one project file, one cable connection, one download
- Dedicated OEM Libraries:
  - PLCOpen Motion libraries for CANopen support of the following devices:
    - ATV31/ATV71
    - Icla range
    - SD3
    - Lexium05
  - Special application libraries for the following applications:
    - Packaging
    - Conveying
- Openness for the integration of 3rd party products via recognised and open standards:
  - I/O devices based on:
    - CANopen
    - Modbus Serial Line
  - Connectivity via Magelis HMI, which supports more than 30 specific communication drivers
    - Siemens
    - Rockwell Automation
    - Mitsubishi
    - Elau

PowerSuite Software Workshop for PC: VW3A8104

- The PowerSuite software workshop is a user-friendly tool designed for setting up control devices for the following devices:
  - Altivar variable speed drive
  - Lexium05 servo drive
  - TeSys model U motor controls
  - Altistart soft starter

- A wide range of functions are integrated for the various application phases, e.g.:
  - Preparing the configurations (for PC),
  - Commissioning (for PC and Pocket PC)
  - Maintenance (for PC and Pocket PC)

- During the start-up phase, the device is connected to a PC and can be used:
  - To transfer the configuration that has been made
  - To make settings
  - For monitoring. New functions have now been added for this option such as the Oscilloscope function.
  - For control
  - To save the final configuration

Contact

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